CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

MOTOR GRADERS maintain road while trucks haul fill for Garrison Dam. See article by J. S. Seybold.

MWD of Southern California Doubles Capacity of Water Softening Plant — Diemer

Aerial Survey Methods Solve Highway Location Problems in Tropics — Pryor

PLAN TO ATTEND ASCE FALL MEETING IN WASHINGTON, D.C., NOV. 2-4

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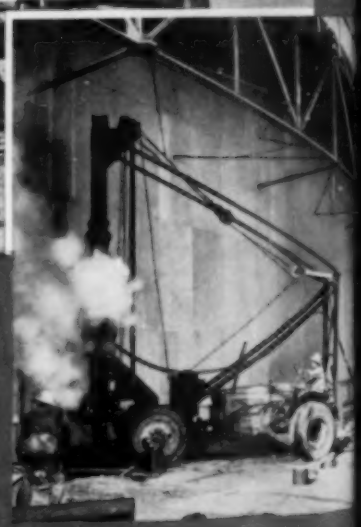

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Ditches too wet, or too muddy, to furnish traction for ordinary graders are handled easily by the A-W machine as in the photo above. Rear Steer puts the back wheels up where the "going is good"—*but only Rear Steer can do it.*

BUILDERS OF ROAD MACHINERY SINCE 1859

Austin Western

Metropolitan Water District Doubles Capacity of La Verne Softening and Filtration Plant

CONSTRUCTION PROGRESSES on second unit of La Verne water softening plant while first unit is in operation. Second unit, here seen under construction, includes twelve filter beds and two straight-line-type clarifiers on far side of plant in this view, and twelve zeolite softeners in center foreground. First unit, of same capacity, consists of twelve filter beds and two center-feed clarifiers on near side of plant as well as administration building and twelve zeolite softeners adjacent to it.

R. B. DIEMER, M. ASCE

Chief Operation and Maintenance Engineer, Metropolitan Water District of Southern California, Los Angeles, Calif.

CONSTRUCTION OF the second unit of the softening and filtration plant at La Verne, Calif., to meet increasing demands for Colorado River water, has recently been completed by the Metropolitan Water District of Southern California. Increases in population in the District and the extended drought over the past five years in Southern California have greatly increased the demands for Colorado River water, which is at present being served to approximately 3,500,000 people in the 28 cities now comprising the District. During the summer of 1947, demands for Colorado River water exceeded the softening and filtering capacity of the present plant. The capacity of the initial installation, which was completed in 1941, was for 100 mgd with provision for eventual enlargement to 400 mgd when required. The recent construction, here described, increases the plant capacity to 200 mgd.

EXPERIENCE GAINED during seven years of operation of the first unit of the La Verne water softening and filtration plant revealed that certain changes were necessary for more efficient operation and maintenance. The second unit, just completed, incorporates these changes in design while providing the same treatment process. The general plan of the plant, including the second unit, appears in Fig. 1.

The original installation, which was put in operation in June 1941, included main influent and effluent concrete conduits of 12-ft 8-in. diameter, headhouse, chemical feeders and administration building for the ultimate development of 400-mgd capacity, together with mixing and settling basins, rapid sand filters and zeolite softeners for 100-mgd capacity. The location of the plant with respect to other features of the District's project is shown in Fig. 2.

Lime-Zeolite Process Adopted After Study

Prior to the initial construction, extensive studies were made by the District, extending from 1933 to 1938, to determine the most economical process for softening Colorado River water, which had an average hardness of 365 ppm. Estimates made by the District engineers indicated that the cost of operating a lime-zeolite plant was below that of a lime-soda-ash plant and more than offset the cost of installing zeolite softeners, including the cost of the brine disposal line. A drain line 25 miles in length, extending from the plant to a Los Angeles County Sanitation District trunk sewer, was necessary to dispose of waste brine.

MECHANIZED BUGGIES of 9-cu ft capacity deliver concrete for placement in dividing slab of settling basin No. 4. Special wooden ramps accommodate buggies, powered by 5-hp gasoline engines. Concrete was transported from batching plant located on east side of site in 3½-cu yd transit mixers to convenient points for discharge into buggies.

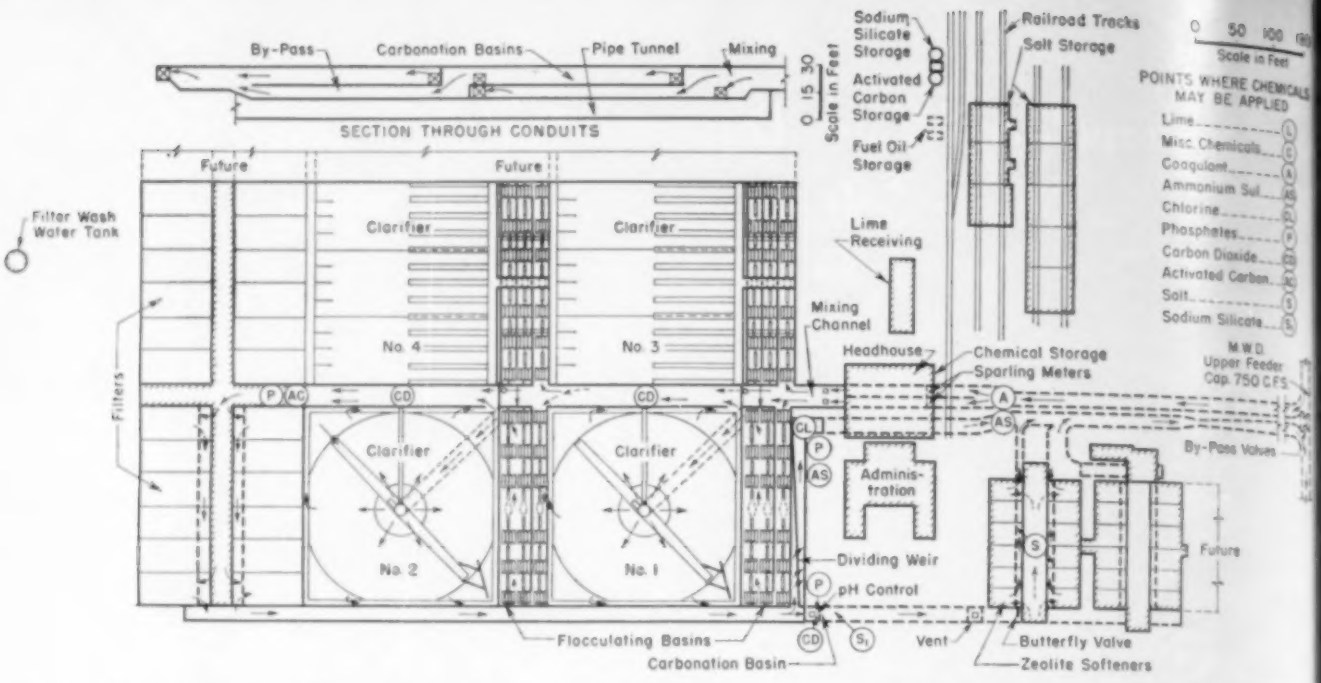


FIG. 1. LATEST FEATURES of design and operation to secure softness yet avoid corrosive properties are incorporated in La Verne water treament plant of Metropolitan Water District of Southern California. As now expanded to two units, total plant capacity is 200 mgd, or 310 cfs. Plan shows flow through plant and locations where various chemicals are applied.

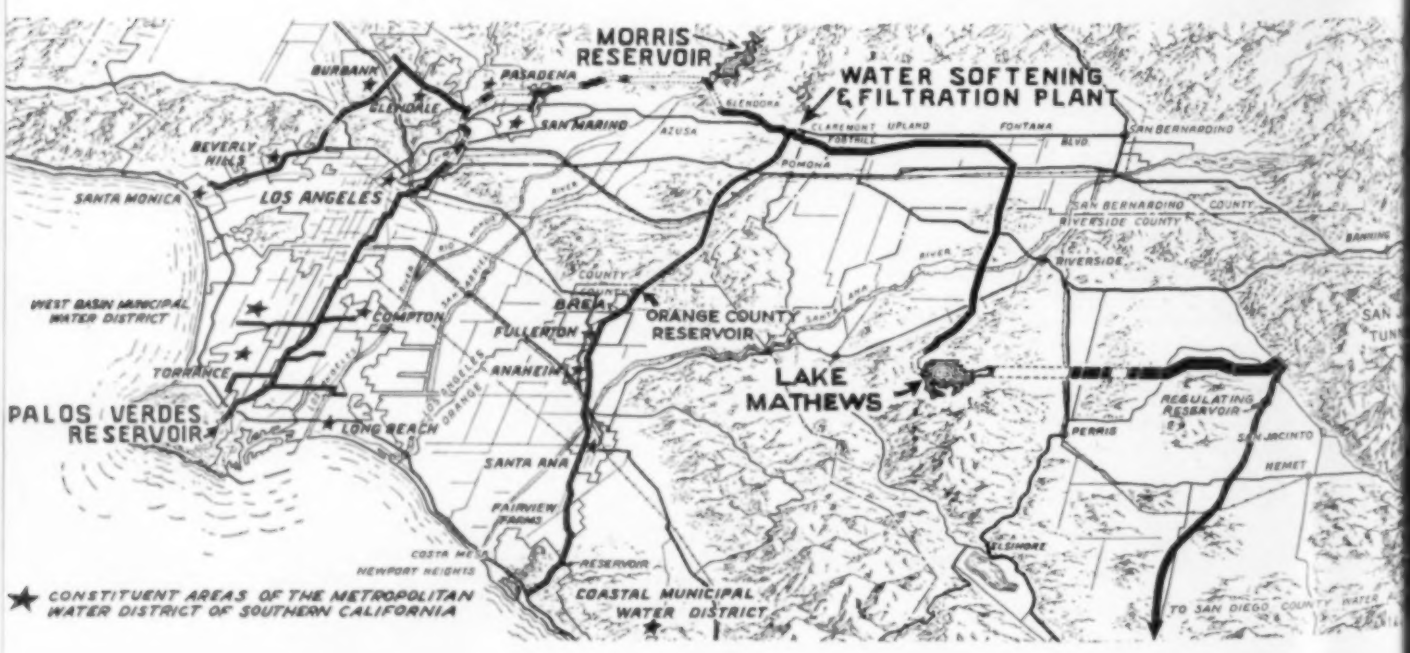
One of the principal problems considered in selecting the softening process was disposal of the sludge produced. The only means available was lagooning of the sludge on low-value lands. The lime-zeolite process was estimated to reduce sludge disposal requirements approximately 30 per cent below those for the lime-soda-ash process. To aid in selecting the best method of treatment, studies were made as to the availability of salt and soda ash which would be required for the initial and ultimate plants. Salt was available in unlimited quantities from nearby sources on the desert at a delivered price of approximately $4.40 per ton, but it was found that soda ash might be difficult to obtain at reasonable prices. After careful consideration of all factors, the lime-zeolite process was selected as the most economical for the softening of Colorado River water.

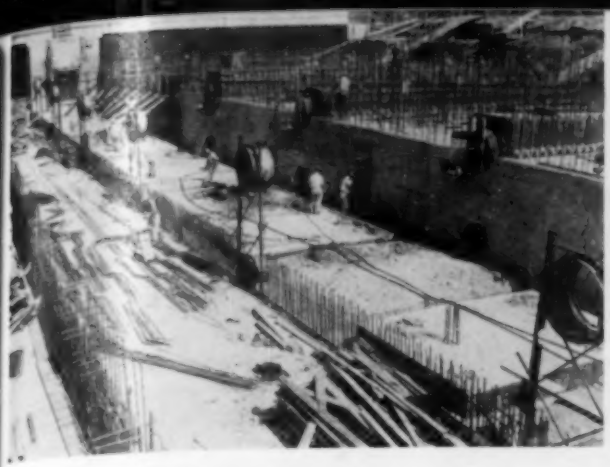
Soon after the plant was put in operation, during the war period, this decision was proved to have been a wise one for costs of lime delivered rose from $6.75 to $22.50 per ton. The present price of lime delivered is $19.50 per ton. Soda ash was not available at any price, while the price of salt did not increase over that for which it was contracted in 1941. Softening of Colorado River water from a hardness of 350 ppm to 125 ppm for labor, maintenance, and chemicals since 1941 has cost approximately $9.35 per acre-ft. Of this cost, $3.00 was for labor and maintenance.

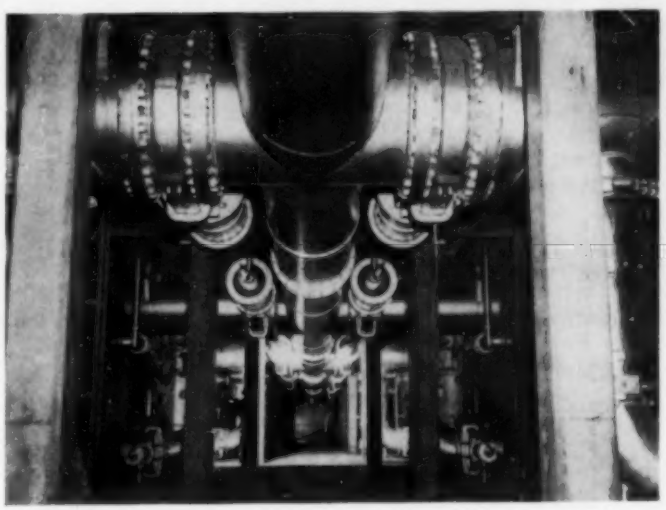
Design Improvements Incorporated in Addition

One of the principal changes in design made in the recent addition to the plant was in the settling basins. The original plant had a center-feed-well, peripheral-overflow type of unit. The second unit has a double-deck cross-flow type in which the water enters the lower deck, passes through its full length and returns on the upper deck to the collecting weirs.

FIG. 2. WATER softening plant at La Verne has strategic location for treating Colorado River water to serve cities of Metropolitan Water District of Southern California in Orange and Los Angeles Counties.







TWELVE RAPID SAND FILTERS in second unit, just completed, have identical design as twelve filters in initial unit. In construction view, top left, pipe thimbles are being placed in new filter building to avoid necessity of boxing out space for later installation of pipes. In view of completed filters and filter building, top right, new filters are at left, original ones at right. Operating room of filter building, looking east from old unit into new, is seen in view at right center. Completed filter pipe gallery, seen in bottom view, also looking east, contains 36-in. backwash main and feeder lines at top, and at bottom, 24-in. effluent lines and flow controllers with pneumatic air transmitters on sides.

Both types of basins are shown in Fig. 3. The new basins are equipped with Link Belt straight-line sludge scrapers. One notable feature of the new basins is that the sludge-removal mechanism travels in the same direction and at approximately the same speed as the water passing through the basins, and the same mechanism scrapes both the top and the bottom decks. The weir overflow rate in the new unit is 25,400 gal per day per ft of weir as compared to 65,100 gal per day per ft of weir in the original unit. The detention time in the basins for both units is two hours at rated plant capacity.

Because of the change in design of the settling basins, a change in the mixing basins was made to permit full cross-flow entrance conditions into the new settling basins. A 30-min detention period is provided in the flocculators.

The new rapid sand filters are identical in design to the original filters. The twelve new filter units, each with a sand area of 1,930 sq ft, provide rated plant capacity when operating at 3 gpm per sq ft of sand area. Each filter contains 24 in. of gravel and 24 in. of sand.

Zeolite Softeners Easily Serviced

The twelve zeolite softeners in the new unit will operate up-flow, as do those in the original unit, with the salt brine regeneration process functioning semi-automatically. The old plant did not provide for access to the softener influent valves for maintenance without a complete plant shutdown. The new zeolite softeners are designed so that each can be serviced individually. Provision is also made to regenerate one softener on each side of the new unit at the same time, which is not possible in the first unit. The new basins are also deeper to permit the installation of additional zeolite. The increased zeolite capacity and the new regeneration procedure will permit more continuous full-scale operation of the softener units. The new basins will have a depth of 4 ft of zeolite or a volume of 2,520 cu ft as compared to a 3.5-ft depth and a volume of 2,206 cu ft in the old basins. The new plant requires 30,240 cu ft of zeolite to fill the 12 basins to capacity, which brings the total for the entire plant to 56,710 cu ft.

After the contract for the construction of the plant addition was awarded, a change was made in the design of the zeolite softeners. To obtain an increased zeolite volume, from 2,206 to 2,520 cu ft per softener, the District had remodeled one of the original softeners and installed porous plates to determine the efficiency of this type of underdrain system. The original zeolite softeners contained a header and lateral underdrain system of transite pipe with openings at 12-in. centers equipped with brass umbrella strainers. The designs for the new plant specified the porous-plate type of underdrains.

False-Bottom Underdrain System Adopted

The tests, which extended over a period of six months, showed that under existing operating conditions porous plates cannot be used, because they become fouled with an after-precipitate of aluminum hydroxide. Consequently the design of the new unit was modified to use a false-bottom type of underdrain system, consisting of precast concrete blocks 2 ft × 2 ft × $3\frac{1}{2}$ in. thick, with 1-in. brass pipe capped with brass umbrella strainers cast into the concrete on 12-in. centers. This false bottom is covered with 20 in. of graded gravel on which is placed 4 ft of zeolite.

MIXING AND SETTLING BASINS for second unit of plant have double deck and are equipped with straight-line scrapers (see Fig. 3). In this view, filter beds are seen under construction in extreme background and concrete batching plant is in operation at far right.

To provide the additional storage for salt needed in the zeolite regeneration process, five additional salt basins were constructed with a total capacity of 3,750 tons, bringing the salt storage capacity of the plant up to 6,000 tons. Turbid brine coming through the pressure filters in the initial installation prompted a change in the design of the new plant, in which three gravity brine filters are provided, each with a 50-sq ft sand area, and designed to operate at a rate of 2 gpm per sq ft.

Six Cars of Salt Required Daily

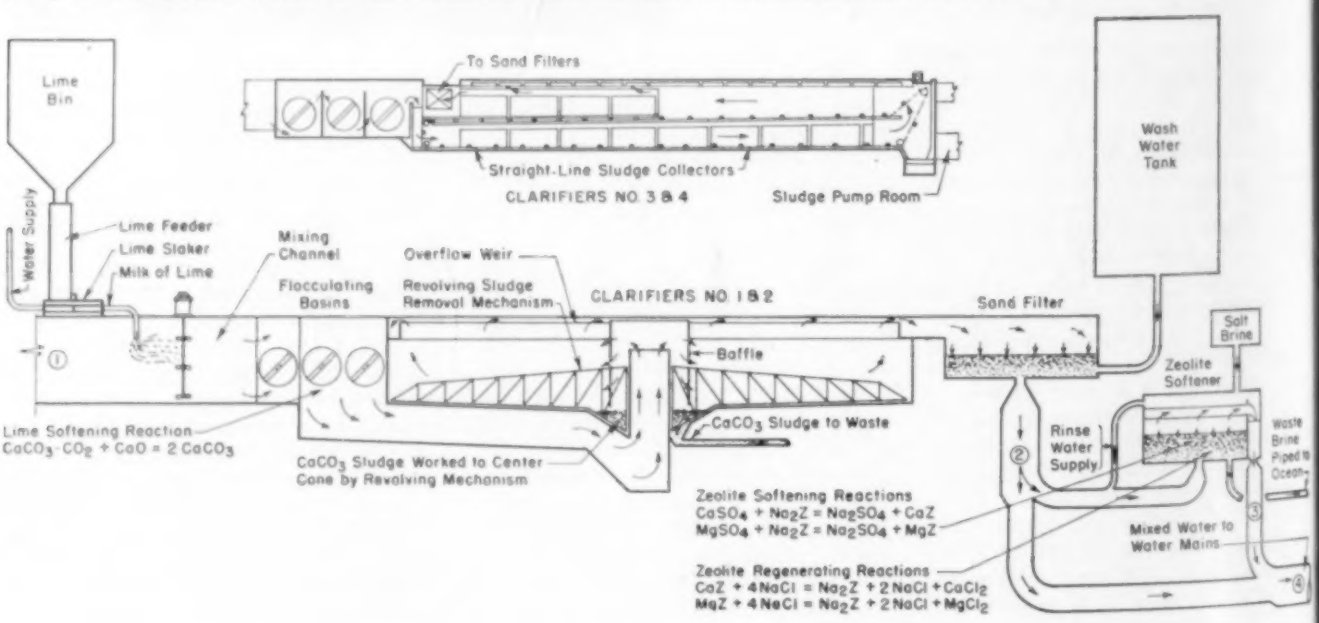
The saturated brine from the salt storage basins is pumped to the brine filters. A storage capacity of 15,000 gal is provided under the filters for filtered saturated brine. During the past year over 50,000 tons of salt were used by the District in the zeolite softening of 74,000 acre-ft of water. When the new plant is operated at capacity, a total of six cars of salt will be required daily.

Another change of design in the new plant affects the method of adding lime to the finished water for pH control. The method of operation at the softening plant is to partially lime-soften and filter all the water entering the plant. About two-thirds of this water is further softened to zero hardness by passing through the zeolite softeners. This zeolite water is then blended with the bypassed water to obtain the desired finished water hardness of 125 ppm. Lime for pH correction of the finished water in the present plant is being added in the bypass channel, sufficient lime being added to raise the pH of the final blend with the zeolite water to the desired point to prevent corrosion. The bypassed water is not softened as far as possible with lime, owing to the necessity of maintaining a relatively high alkalinity, so the addition of lime for pH correction tends to further soften this water. As a result a precipitate is formed which produces a slight turbidity in the finished water. To eliminate this precipitate, two lime feeders and slakers are included in the new plant so that lime can be added for pH correction to water of zero hardness, which water has had the pH lowered by carbonation ahead of softening to prevent the zeolite from causing incrustation. In this way the final blend of zeolite-softened and partially lime-softened water will be clear and of sufficiently high pH to make it non-corrosive.

Concrete Moved in Mechanized Buggies

In constructing this second unit of the La Verne plant, a concrete batching plant was erected on the east side of the site. Concrete was transported from the plant in $3\frac{1}{2}$-cu yd transit mixers to convenient points for discharging into mechanized buggies for transportation to points of placement. Owing to the position of the facilities under construction with relation to the existing plant structures, which continued to operate during construction of the addition, the concrete had to be placed either from one side or from the ends of the structure. In this case, it was decided to transport the concrete from the mixers to the point of placement, a maximum distance of 250 ft, in

FIG. 3. FLOW CHART of La Verne, Calif., water softening and filtration plant also shows cross sections of clarifiers Nos. 1 and 2 (old) and Nos. 3 and 4 (new). Settling basins in second unit embody results of experience with clarifiers in original unit. Initial installation consists of two Dorr Squarex circular center-feed clarifiers (1 and 2). Two clarifiers in second unit (3 and 4) are double-deck basins with Link-Belt straight-line drag-type scrapers. Chemical reactions which take place in softening processes are indicated.



mechanical buggies of 9-cu ft capacity.

These buggies are powered by air-cooled, 5-hp gas engines and make an average 400-ft haul round-trip in about $1\frac{1}{2}$ min. It was necessary to construct heavy timber runways for the buggies, weighing one ton loaded, to operate on. The cost of the runways was considerable but the contractor decided on this method of placing the concrete after considering other methods involving pneumatic placing equipment, crane and bucket, and hand buggies. The average daily pour was about 125 cu yd and the maximum 325 cu yd.

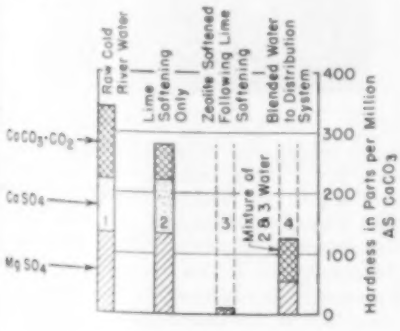
Plywood Forms Used

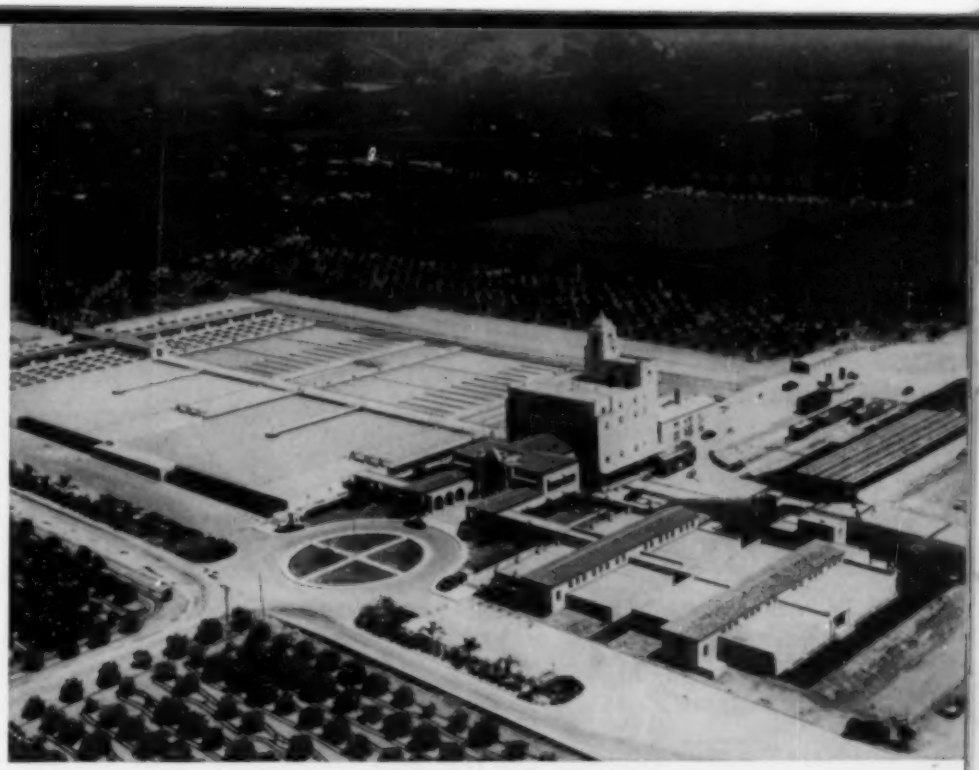
Plywood forms were used throughout except for the floor in the upper deck of the settling basins, where steel pans supported by timber substructure were used. Thimbles for the pipes leading into the sand filters and zeolite softeners were placed in advance of the concrete to avoid the necessity of boxing out space for later installation of the pipes. Because of the necessity for watertightness in conduits and basins, an attempt was made to minimize shrinkage cracks by limiting wall pours to 45-ft sections, and all construction joints were sealed with copper water stops. An architectural finish of smooth and even texture was required for all exposed concrete surfaces in the filter and zeolite softener buildings, for connecting arcade exteriors above the finish grade, and for the interior of these buildings above the operating gallery floor.

Main Contracts and Subcontracts Let

Construction of the original plant was completed in June 1941 at a total cost of approximately $3,000,000. In addition a brine waste line costing $450,000 was constructed.

FIG. 4. THREE MAIN STEPS constitute water softening process at La Verne plant. Treatment with lime and zeolite and final blending are accomplished in steps numbered to correspond with locations marked in Fig. 3.





COMPLETED AND IN OPERATION, second unit of softening and filtration plant at La Verne, Calif., together with initial unit, serves 3,500,000 population in Metropolitan Water District of Southern California. Dedication ceremonies on August 31, 1949, marked completion of $4,000,000 addition.

This line, of concrete pipe, has an average diameter of 24 in. and a length of 25 miles.

The general contract for the second unit of the plant was let on February 11, 1948, to the L. E. Dixon Co. of San Gabriel, Calif., for $2,592,400. During the early part of 1947, the District had awarded contracts to various manufacturers for furnishing mixing and settling-basin equipment, rate-of-flow controllers, pumps, valves, plant-control equipment, and meters. The total cost of the expansion facilities, including district-furnished equipment, engineering and administration, is about $4,000,000.

The general contract provided for the construction of mixing and settling basins, filters, zeolite softeners, salt storage bins, and related structures, all of reinforced concrete. It also included the installation of all mechanical equipment in the mixing and settling basins, hydraulically operated gate valves and butterfly valves, check and float valves, plug valves, rate-of-flow controllers, plant-control equipment, propellor-type meters, pumps, lime feeders and slakers, and filter and zeolite softening operating tables. The major quantities included in the construction were: Excavation, 77,000 cu yd; reinforcing steel, 2,450 tons; concrete, 21,000 cu yd; piping, 350 tons; and structural steel, 100 tons.

The contractor entered into subcontracts for a large part of the work, subletting the earthwork, reinforcing steel, piping, plumbing, and hydro-pneumatic systems, electrical work, structural steel and miscellaneous metal work, painting and enamel work, terrazzo floor and tile roofing. The general contractor took care of the concrete work.

The largest subcontract covered general piping and plumbing work amounting to approximately $500,000. The progress of the contract followed very closely the program outlined by the contractor at the start of the work. There were no delays caused by non-delivery of equipment or materials or by labor problems.

Dedication Ceremonies Mark Completion

On August 31, 1949, dedication ceremonies were held to mark the completion of the $4,000,000 second-unit addition to the La Verne plant.

The District's operations were carried on under the direction of Julian Hinds, Director ASCE, General Manager and Chief Engineer, with the writer in general charge of construction. H. J. Mills, Assoc. M. ASCE, Construction Engineer, was in direct charge in the field. Designs were made by District engineers under the direction of R. A. Skinner, Assoc. M. ASCE, Office Engineer, with valuable assistance given by W. W. Aultman, M. ASCE, Water Purification Engineer, and J. M. Montgomery, M. ASCE, consulting engineer. The contractor's operations were carried on under the direction of W. L. Squiers, Project Manager, and Roy S. Knapp, Superintendent.

SNOW SAMPLING PARTY travels up trail on skis at high altitude on Baker Creek snow course, White Pine County, Nevada. Man in lead carries pack containing sampling equipment (see close-up of pack and contents below). Party usually consists of two men. Snow forecasting work in Nevada is done by the Nevada Cooperative Snow Surveys. Weather and other conditions are not always auspicious and several lives have already been lost in survey work.

Nevada Utilizes Modern Methods in Forecasting Runoff from Snow Cover

KRISTIAN TONNING

Norwegian Exchange Student, Department of Civil Engineering, University of Nevada, Reno, Nev.

SNOW SURVEYING and runoff forecasting have great economic importance in the western United States, where rapid growth and development have placed a tremendous demand on limited water resources. In the effort to utilize the available water with maximum efficiency, engineers have been faced with many challenging problems, among them that of determining ahead of time what the summer runoff is likely to be.

Since about 75 percent of the water used in the West originates as snow on mountain watersheds, the runoff can only be forecast by measuring the snow cover. The forecasting of runoff by measurement of snow cover has been developed to the point where the economic life of the West is dependent upon it.

The great waterfalls of Norway have popularly been called the "white gold of Norway" because of their potentialities for hydroelectric development. Similarly, the snow cover on the mountain watersheds of the Western United States might properly be called the "white gold of the West."

Snow surveying is a new science and, like most inevitable things, it has had several births though few survivals. Several names could be mentioned in connection with the development of snow surveying, but if only one is given it should be that of Dr. J. E. Church of the University of Nevada, considered to be the father of modern snow surveying. His study of snow has brought him international fame.

Snow surveying as performed today can be split into three main phases:

1. Selection and layout of snow courses.
2. Taking of measurements.
3. Forecasting of expected runoff.

All three phases are so closely related that it is impossible to give one more weight than the others.

The object of the performance of a snow survey is the forecasting of expected runoff. To make a satisfactory forecast, dependable measurements must be taken, and this in turn depends upon the location of snow courses. No definite rule for the establishment of snow courses can be given, but certain requirements should be observed. Since the aim is chiefly to determine the expected runoff during the spring and early summer months, the measurements should be taken at elevations where little or no melting occurs before the beginning of April. Because of this requirement, the snow surveyor may have to travel far into the mountains, and his trip may become long and difficult, but the results obtained are felt to be worth the effort. A snow course should be of such a character that it is accessible at any time during the winter months. Even though the main interest is in the March–April survey, it is desirable to obtain measurements at the most important points every month from January to April.

Each snow course should be so laid out that the average of the measurements taken will represent the snow cover at the given elevation and exposure. Measurements are therefore taken at a sufficient number of points to insure that the average will not be unduly affected by drifting or wind-swept snow. Sheltered flats or meadows usually prove to be satisfactory locations for a snow course, provided the area is open enough to permit the snow to reach the ground without being intercepted.

How Snow Cover Is Measured

Many people have the idea that the actual snow surveying consists of measuring snow depths. This is partly right but it does not include the main idea on which snow-surveying practice is built. The depth of the snow alone does not give much information as to the runoff that can be expected. The amount of runoff depends rather upon the water content of the snow, and it is not possible to establish any relationship between snow depth and water content.

Approved procedure for determining the water content of snow consists essentially in procuring vertical cores of a small diameter at points

PACK CONTAINS all equipment needed for snow sampling: Sections of duraluminum tube 30 in. long, driving wrench (lower left), scales (top center), map giving locations of sampling stations on course, and form for recording data (both, lower right). Steel cutting bit (top, second from right) has edge on inside so as to retain snow core when tube is withdrawn.

earlier established along the snow course. The instrument used for cutting of snow cores is called a snow sampler. The snow sampler in most common use today consists of sections of hollow duraluminum tubing each section being 30 in. long. By joining the sections of tubing together, a sampler can be formed which is capable of taking core samples in snow that is well over 20 ft deep. The end is provided with a steel cutting bit, thus making it possible to drive the sampler through hard and deep snow. The cutting bit is provided with an edge on the inside so as to hold the snow core in the sampler when it is withdrawn.

Water content of the snow core is determined by weight. A spring or dial balance which has previously been calibrated for the weight of the empty sampler is read in ounces. By making the inside diameter of the cutting bit 1.485 in., the weight of snow in ounces is made equal to the water content in inches of depth, as can be demonstrated mathematically.

After the measurements are taken and recorded, the records go to the main offices in the different areas, where the forecasts are prepared. Water supply forecasts based on snow surveys are made on the assumption that there is a simple relationship between the water content of the snow cover on a drainage area and the runoff from that area.

Forecasting Involves Indeterminable Factors

This principle may sound simple, but actually so many undeterminable factors enter the picture that the forecasting of runoff is a very difficult task. Excessive or deficient spring precipitation in the form of rain will affect the runoff correspondingly, and even fall precipitation will influence the spring runoff because of its effect on the ground-water table and moisture content of the earth.

The principles of the percentage method are commonly used for forecasting. This system uses the average measurements on a snow course as an indicator of the water storage in that locality. Then by comparison with previous records of snow cover and runoff, either by charts or graphs, a successful forecast can be made.

When snow surveying was first started, there were only a few snow courses, and to arrive at an average for a drainage basin, a simple arithmetical average was used. However, when more snow courses were laid out it was found that the runoff from some was heavier than that from others, and the method of arithmetical averages was proved unsatisfactory.

1

2

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AFTER ARRIVAL AT MARKER, snow sampling party proceeds as follows: (1) Tube sections are fitted together and one man affixes driving wrench while other helps hold tube. (2) Tube is driven into snow. Because of sharp cutting edge, snow as deep as 20 ft can be sampled. Dirt must be found at cutting end to indicate complete sample. (3) Dirt plug is removed. This must be done before weighing. (4) With scales hung from ski poles, one member of party weighs tube containing snow core while second member records data.

The zoning system was then developed, whereby the drainage basin is divided into zones and the average water content of the snow in each zone is established. When the expected runoff is calculated, each zone is given a different weight factor, which can be established by comparing the areas and the altitudes of the different zones. However, the most dependable method of determining weight factors is by making a study of past records of snow measurements and runoff when these are available.

Even when the foregoing work has been completed, the forecasting of runoff for each basin remains a problem in itself. A method which is suited to one watershed may not apply to another at all.

The quest for knowledge continues. Dr. Church is still active in his efforts to improve and extend the usefulness of an idea which first interested him as a hobby. Many young men have been attracted to the problem of correlating runoff with snow measurements made on established snow courses. The field work required in connection with snow surveys must be made under severe conditions, and several investigators have already given their lives in the advancement of this important science.

The need for water and water power grows more acute as time goes on. The national welfare requires that efforts be continued to make the most effective use possible of the "white gold of the West."

4

This article was originally presented in a student paper competition at the San Diego Conference of ASCE Local Sections and Student Chapters. The author's studies at the University of Nevada were directed by Prof. Howard B. Blodgett, M. ASCE, head of the Civil Engineering Department. The photographs are used through courtesy of the Soil Conservation Service, U.S. Department of Agriculture.

Field Bearing Tests Verify Laboratory Findings

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FIELD BEARING TESTS for foundations have been superseded to a great extent by the laboratory methods of modern soil mechanics, which determine the bearing values of soils with sufficient accuracy in most cases to render field bearing tests unnecessary. However, for the design of important structures and for the solution of problems concerning the validity or applicability of laboratory test results, actual field bearing tests provide an effective method of obtaining additional design data. Where undisturbed samples of the foundation materials cannot be obtained, and in areas remote from laboratory facilities, field tests may be the only means of determining foundation bearing values.

To perform a field bearing test properly and arrive at a useful quantitative conclusion, it is first necessary to determine whether the problem of soil settlement or that of soil strength is paramount. The material must be loaded to failure to determine its strength, but such loading may not always be necessary to determine the settlement or deformation characteristics necessary for design. The distinction is important, since it will influence the capacity of the loading equipment and the method of loading required.

A field bearing test is generally made by applying loads at some predetermined rate to a bearing plate or pedestal. The load may be applied rapidly or slowly, depending principally on the type of material and the anticipated rate of construction of the structure. To determine the settlement characteristics of compressible soils, the load is applied very slowly, allowing complete deformation under each load increment. Such tests are not popular because they take too long, but where they are necessary and practicable, they can be evaluated by equations of Karl Terzaghi and O. K. Frohlich.[1, 2]

Field tests for settlement characteristics of rock are not in frequent demand, being required only for major structures on relatively weak rocks. Both the elastic characteristics and the strength of the material can be determined from the same test if the capacity of the loading apparatus is sufficient to produce rupture or flow in the material tested. The modulus of elasticity of rock can be found by a bearing test, since equations have already been developed to give the relations between load, settlement, and elastic properties.[3] An interesting series of tests of this type was made in connection with the Third Locks Project for the Panama Canal.[4]

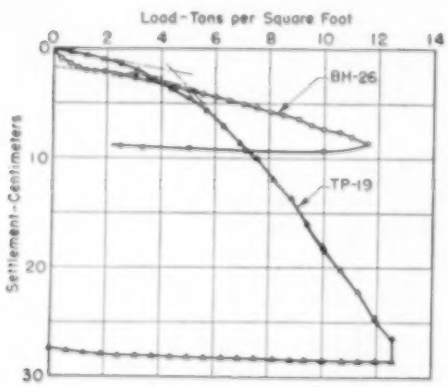


FIG. 1. LOAD SETTLEMENT CURVES represent results of field bearing tests in two pits, named BH-26 and TP-19. Load of 0.3 ton per sq ft per min was applied by jack on bearing plate up to maximum of 11.6 tons per sq ft in pit BH-26 and 12.6 tons per sq ft in pit TP-19.

Tests for Agua Fria Dam

These principles were applied in the field loading tests and laboratory shear tests made in connection with the design of Agua Fria Dam near Caracas, Venezuela, where the problem concerned the determination of the strength of weathered schist. The dam site, about 20 miles west of Caracas, was thoroughly explored in 1942, and the construction of an earthfill storage structure about 135 ft high was planned. The site of the right abutment was composed of mica schist so badly leached and weathered that it would normally be classified as a soil rather than a rock. From the standpoint of stability, this schist was considered to be the most critical material at the site.

Undisturbed schist samples were obtained from two test pits, designated BH-26 and TP-19. The samples were taken carefully and transported by native packers and car to Caracas, where they were tested under the direction of Eugene V. Barrett, Director of the testing laboratory of the Venezuelan government (Laboratorio de Ensayos de Materiales, Ministerio de Obras Publicas). Direct shear tests were made on four fully saturated samples. Results are shown in Table I. Values ranged from 0.09 to 0.27 ton per sq ft for cohesion and from 29.0 to 38.0 deg for the angle of internal friction.

Since leached rocks similar to this schist have caused trouble in dam foundations in the past, some additional verification of the test results was felt to be desirable. On recommendation of Joel D. Justin, Director, ASCE, consultant on the project, a field bearing test was decided on. Subsequently two bearing tests were made, one in each of the two test pits from which the laboratory samples had been procured.

Owing to the distance of the dam site from the nearest road and the shortage of trained labor, it was necessary to keep the amount of skilled work and heavy equipment to a minimum. Therefore the tests were made by jacking a bearing plate laterally against the vertical wall of the pit, so as to eliminate the heavy counterweights or anchors required to withstand the reaction of the jack in the conventional type of vertical bearing test.

Field Tests Made in Two Pits

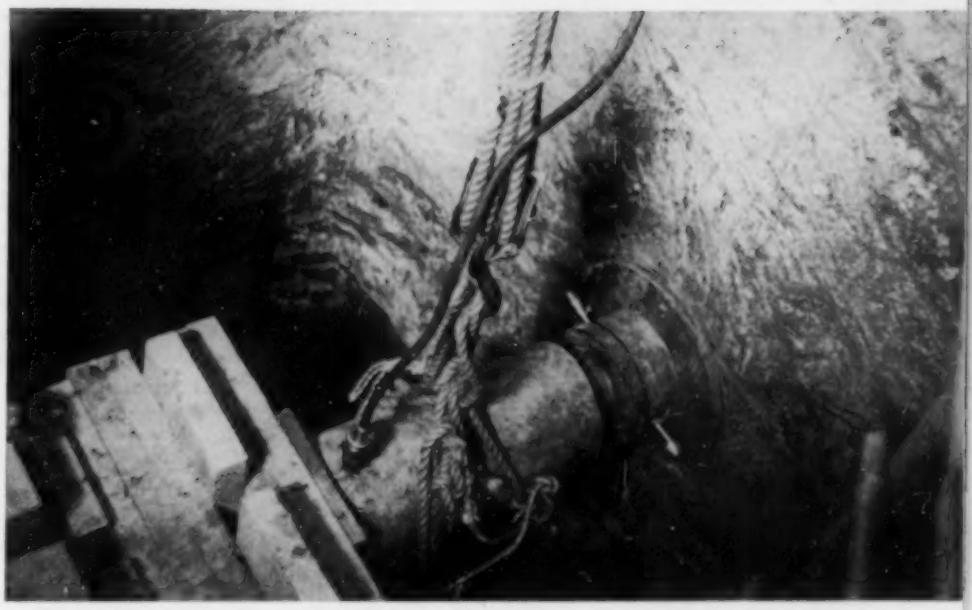
The test pits were approximately 6 ft square and 14 ft deep. A steel plate, about 15 in. in diameter and $^3/_4$ in. thick, was suspended from the top of the pit adjacent to the side to

TABLE I. RESULTS OF LABORATORY TESTS ON FULLY SATURATED SAMPLES

Test Pit	Sample No.	Dry Wt., Lb per Cu Ft	Moisture Content, %	Angle of Internal Friction, Deg.	Cohesion, Tons per Sq Ft
BH-26	2	...	...	29.0	0.27
	40	96	12.8	38.0	0.09
	1	98	...	...	...
TP-19	5	...	15.1	33.4	0.16
	42	102	9.6	36.1	0.09
	3	...	...	...	...

be tested. The center of the plate was 7½ ft below the ground surface and 6½ ft above the bottom of the pit. A hydraulic jack of 100-ton capacity was also suspended from the top of the pit, with the ram in a horizontal position. A spherical block and socket, such as is used for laboratory compression tests, was suspended from above, between the jack and the bearing plate, to assure centering of the load. The reaction of the jack was transmitted to the pit wall opposite the bearing plate through a heavy timber grillage about 5 ft square. The jack was connected by flexible tubing to a receiver and hand pump at ground level. A Bourdon gage, attached to the receiver, was used to indicate pressures. Water was used as a pressure medium. Two wire plumb-lines, set on each side of the jack near the bearing plate, served as reference lines for measuring the deflection of the plate.

After lining up and leveling the equipment, the ram of the jack was extended until contact was made with the bearing block and a zero pressure measurement was taken. Pressure on the bearing plate was then applied in increments of approximately 0.3 ton per sq ft per min. Deflection of the bearing plate was measured immediately before applying a load increment. After the maximum load was reached, the pressure was reduced, and the deflections during rebound were measured. The maximum load applied was 11.6 tons per sq ft in test pit BH-26, and 12.6 tons per sq ft in test pit TP-19. Results are shown graphically in Fig. 1.



FIELD LOADING TESTS on weathered mica schist are made by jacking 15-in.-dia bearing plate laterally against vertical wall of pit. Tests were made in two pits each 6 ft square and 14 ft deep, from which samples had previously been taken for laboratory tests.

Two Pits Give Similar Results

The load-deformation curves are typical of tests of this type. The deformation is nearly proportional to the load for low load intensities. As the load is increased, the deformation increases at a greater rate than the load until some limiting rate is reached. Still further loading beyond this limiting value is accompanied by more or less proportionate deformation at the higher rate. For example, the test in TP-19 shows that deformation is roughly proportional to load up to a maximum load of about 2 tons per sq ft. For loads between about 2 and 6 tons per sq ft, the slope of the curve increases rapidly with increasing load. For loads greater than 6 tons per sq ft, the slope again becomes relatively constant.

Similar behavior is indicated by the curve for the test at pit BH-26, if we disregard the initial deformations, which were inordinately high because the bearing plate was not in good contact with the soil surface at the start of the test.

The shape of the load-settlement curves of Fig. 1 indicates two distinct relationships between load and deformation and a transition state leading from one to the other. The relatively flat portion of the curve, for loads smaller than about 2 tons per sq ft, appears to indicate a proportionality between load and deformation. Within this load range the soil deforms like an elastic material under compression. For loads between about 2 and 6 tons per sq ft, the rapid increase in rate of deformation seems to indicate a yield. A state of flow apparently began in some region within the soil at an external load of about 2 tons per sq ft. As the external load was increased, the region subject to yield or flow probably increased in extent. By the time the load had reached 6 tons per sq ft, the region of flow had probably spread to include all or a major part of the stressed material beneath the bearing plate.

For loads in excess of 6 tons per sq ft, the rate of deformation had reached a state of equilibrium for the rate of load application used. It is probable that the slope of the curve for loads greater than 6 tons per sq ft would have been somewhat different for a different rate of load application. The important point is not the true slope of the two portions of the curve but rather the points or loads at which the slope of the curve changes because those points indicate the loads at which local failure and general failure occurred. In this case local failure probably began at approximately 2 tons per sq ft and progressed until general failure occurred at about 6 tons per sq ft.

Slippage or flow no doubt began at points of stress concentration under the edges of the bearing plate and progressed along the trajectories of maximum shear until the entire mass subject to stress became plastic. The effect was similar to that of a metal plate punched by a rigid die.

Quantitative Determination of Stresses

With the foregoing qualitative analysis as a basis, the quantitative determination of stresses within the soil mass was made by known equations. The problem was treated as a three-dimensional problem in elasticity. The loaded surface was assumed to be plane and infinite in extent, and the load was assumed to be uniformly distributed over the area of the bearing plate, although neither of these assumptions was strictly cor-

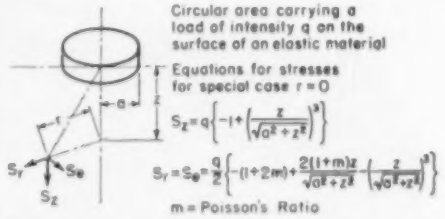


FIG. 2. SKETCH illustrates method of determining stresses at point in elastic solid subjected to uniform load on circular area at its surface.

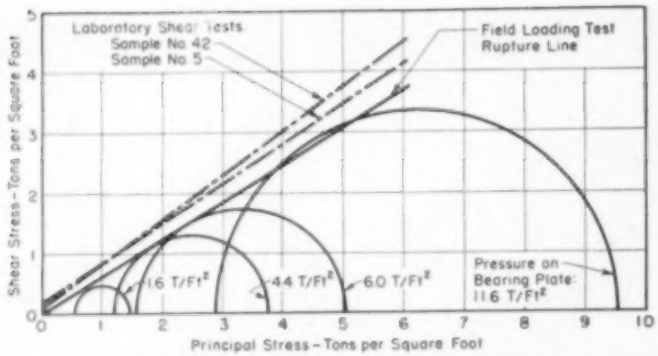


FIG. 3. MOHR'S CIRCLES for calculated combined stresses are plotted for field loading test in pit TP-19. True rupture line is considered tangent to circle corresponding to pressure of 6 tons per sq ft, at which load yielding occurred. Line is drawn through origin of coordinates on assumption that material is cohesionless.

rect. The wall of the test pit was approximately 6 ft wide and 14 ft deep rather than infinite in extent. However, the bearing plate was only 15 in. in diameter, so the actual error involved in assuming a plane loaded surface extending to infinity in all directions was probably not large.

The error introduced by assuming uniform distribution of pressure over the loaded area was large at the surface of contact. Owing to the rigidity of the bearing plate, the surface pressure was probably much greater at the edges of the plate than at the center. This lack of equality was greatest at the contact surface and decreased in importance at increasing depth within the soil mass. The inequality of surface pressure tended to become relieved during the loading process because of plastic flow. The highly stressed areas yielded first, and those of lesser stress carried more and more of the increased load on the bearing plate. The net effect was a trend toward uniform distribution of pressure as the load increased.

Principal Stresses Within Loaded Mass

The principal stresses within the loaded mass were determined by the theory of elasticity. To these were added the gravity stresses of the mass itself. It was assumed that failure occurred in accordance with the theory of maximum shear. The maximum - shear stress was taken as one-half the difference between the greatest and least principal stresses, in accordance with accepted practice. The equations used for stresses due to the loaded plate were taken from Timoshenko.[3]

Principal stresses at the point of maximum shear stress on the axis of the load were computed from the following equations. The various relationships are shown graphically in Fig. 2.

$$s_z = q\left[-1 + \left(\frac{z}{\sqrt{a^2 + z^2}}\right)^3\right] \ldots (1)$$

$$s_r = s_\theta = \frac{q}{2}\left[-(1 + 2m) + \frac{2(1 + m)z}{\sqrt{a^2 + z^2}} - \left(\frac{z}{\sqrt{a^2 + z^2}}\right)^3\right] \ldots (2)$$

The shearing stress, $\frac{s_z - s_r}{2}$, has its maximum value at the depth:

$$z_{max} = a\sqrt{\frac{2(1 + m)}{7 - 2m}} \ldots\ldots (3)$$

where:

- s_z = stress in direction of axis of load
- s_r = stress on any radius normal to axis of load
- s_θ = stress in tangential direction, normal to s_z and s_r
- m = Poisson's ratio
- q = intensity of load at surface
- a = radius of loaded area
- z = distance below loaded area measured on axis of load

The equations apply to points along the axis of the load normal to the bearing surface. However, all points of equal intensity of maximum shear stress are defined by spheres passing through the edges of the loaded area. Once the values of principal stress had been determined at the point z_{max}, where the maximum shear has its highest intensity, then the value of maximum shear had been found for all points on the sphere passing through the edges of the loaded area and point z_{max}. Poisson's ratio, m, was assumed equal to 0.5.

To the stresses computed for the pressure q on the bearing plate were added the gravity stresses due to weight of the soil, s_v and s_h, the vertical and horizontal soil pressure, respectively. The combined stresses gave the values of total principal stresses s_1, s_2, and s_3. The vertical component of the soil pressure, s_v, was taken as the unit weight of the soil multiplied by the depth of the center line of the bearing plate below the ground surface. The horizontal component, s_h, was taken as one-half s_v. The stresses computed for the two limiting conditions—that at the beginning and that at the completion of progressive failure—are shown in Tables II and III.

Mohr's circles for the calculated combined stresses are plotted in Figs. 3 and 4. If each circle represented the stresses corresponding to plastic flow or rupture, then the tangent to all circles would give the rupture line of the material. However, in this case failure was progressive, and at depth z_{max}, yielding did not occur until the load on the plate reached 6 tons per sq ft. Therefore, the true rupture line should be tangent only to the circle corresponding to this pressure and circles for lesser loads should all lie below the rupture line. Drawing the rupture line through the origin of coordinates assumes that the material is cohesionless, a safe and fair assumption. Although the material had a slight amount of cohesion, a field loading test at only one depth below the ground surface could not yield sufficient information to evaluate it.

Good Agreement Between Field and Lab Results

Also shown in Figs. 3 and 4 are the results of laboratory shear tests of undisturbed samples. Comparison of the laboratory curves with the rupture lines from the field tests shows good agreement. Both the field bearing tests show a shearing strength of 1.5 tons per sq ft under a normal pressure of 2.45 tons per sq ft, corresponding to the Mohr's circles for an external load of 6 tons per sq ft. The average shear strength determined in the laboratory for the same normal pressure is 1.8 tons per sq ft, a difference of 20 percent from the field results. Had a value of 0.3 been used for Poisson's ratio, the agreement between the field and laboratory tests would have been nearly perfect.

It is interesting to note that the field loading tests, made in two different test pits, gave results in almost perfect agreement, while the laboratory tests showed an appreciable spread, even between two sam-

TABLE II. STRESSES AT START OF PROGRESSIVE FAILURE, AS COMPUTED FROM FIELD TESTS

Stress Symbol	Pit BH-26 at Depth z	Pit TP-19 at Depth z
q	2.00	1.60
s_z	1.62	1.29
$s_r = s_\theta$	0.46	0.37
s_v	0.40	0.42
s_h	0.20	0.20
s_1	1.82	1.49
s_2	0.86	0.79
s_3	0.66	0.57

ples from the same pit. A possible explanation of this difference lies in the difference in volume of material involved and in the orientation of the planes of maximum shearing stress. Each laboratory test curve represented three or more tests on individual small specimens cut from an undisturbed sample. The total of the specimens in each test series probably included only about 0.06 cu ft of material. Furthermore, the specimens were all cut by slicing the sample transversely. Thus, in all tests, the planes of maximum shearing stress had the same orientation.

TABLE III. STRESSES AT COMPLETION OF PROGRESSIVE FAILURE, AS COMPUTED FROM FIELD TESTS

Stress Symbol	Pit BH-26	Pit TP-19
q	6.00	6.00
s_0	4.85	4.85
$s_0 = s_y$	1.38	1.38
s_x	0.40	0.42
s_z	0.19	0.19
s_1	5.04	5.04
s_2	1.78	1.80
s_3	1.57	1.57

Each laboratory test curve represented only the strength along a single plane within a very small region in the ground. On the other hand, each field loading test involved about 0.8 cu ft or more of material and caused shearing stresses on nearly all possible orientations of stress planes. It is probable, therefore, that the field loading tests gave a much better average representation of shearing strength than did the laboratory tests.

The correlation between the field and laboratory tests was utilized in the design of Agua Fria Dam. Because of the close agreement between the two types of test, the average values for cohesion and angle of internal friction obtained from the laboratory tests were used in the design of embankment slopes. Stability analyses were made by the Swedish or slip-circle method.

The method of analysis here presented offers a rational approach to the interpretation of field loading tests and to the correlation between such field tests and shear tests performed in a laboratory. The field method alone can probably be used to obtain safe values of friction and cohesion by the utilization of two or three different sized bearing plates or by performing loading tests at two or more depths below the ground surface. Such an ambitious program of field testing probably would not be economical for ordinary foundation studies or for use in areas where soil testing facilities are available. They would be most advantageous in areas remote from testing facilities and for large-scale undertakings requiring extensive exploratory investigations.

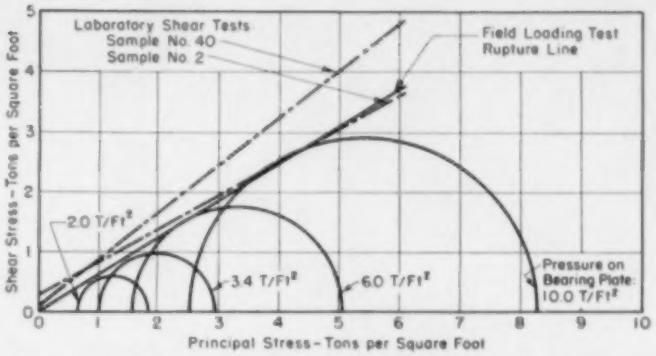


FIG. 4. MOHR'S CIRCLES for calculated combined stresses are plotted for field loading test in pit BH-26. Yielding occurred at same load as in pit TP-19, giving same rupture line as for tests in that pit (Fig. 3).

The investigation here described was conducted by the writer under the general supervision of Gerald T. McCarthy, M. ASCE, Caracas Manager for Parsons, Brinckerhoff, Hogan and McDonald, consulting engineers, designers of the Caracas water supply system. The writer is indebted to Joel D. Justin, Director, ASCE, consulting engineer, and to Carneal K. Smith, Assoc. M. ASCE, Senior Engineer, Corps of Engineers, for their helpful suggestions on the preparation of this article.

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Eighty-Year-Old Bridge Carries Highway Traffic

FORT LEAVENWORTH BRIDGE ACROSS MISSOURI RIVER between Kansas and Missouri has had long and checkered history. Opened to railroad traffic in 1872, but abandoned in 1894 for newer crossing, bridge was purchased by Federal Government in 1920 and converted to highway use. Spans are longest Post trusses ever built in United States—two 337 ft in length and one 312 ft. Panel lengths are approximately 26 ft, truss depth 35 ft, and width of roadway 18 ft. Deck consists of pressure-creosoted stringers and flooring, covered with asphalt mat. Two state highway departments share cost of deck and wearing surface maintenance. E. S. Elcock, Assoc. M. ASCE, is bridge engineer for Kansas Highway Department, and Frederick W. Epps, maintenance bridge engineer; V. W. Enslow is bridge engineer for Missouri Highway Department. Photo through courtesy of "Wood Preserving News."

RIVERDALE, N. Dak., built on terrace on left bank above dam, includes both temporary and permanent housing. When project is completed town will house operation and maintenance personnel. White lines indicate dam site. Just below downstream toe is railroad and highway embankment and construction bridge, which carries single-track railroad and 26-ft roadway.

Constructors Roll Nearly One Million Yards a Week Into Garrison Dam

J. S. SEYBOLD, M. ASCE

Colonel, Corps of Engineers; District Engineer, Garrison District, Riverdale, N.Dak.

WHEN COMPLETED Garrison Dam will be one of the world's largest water controlling structures—in fact the world's largest earthfill dam built by dry-land methods. Its reservoir will stretch 200 miles up the Missouri Valley and drain an area of 180,940 sq miles. Its five power units will produce 400,000 kw. Excavation for the intake, powerhouse, outlet works, and spillway will provide almost all of the 68,000,000 cu yd of fill required in this rolled-earth structure. Eight tunnels about 30 ft in diameter are being constructed as part of the structure. Of these, five will serve as penstocks and three will be used for flood control. Before constructing any of the tunnels, a test tunnel was dug to obtain design data. Garrison Dam is the second unit in the Pick-Sloan Plan for the control of the Missouri River. When completed in 1954, it will share with the Fort Peck Dam, the first unit in the plan, the task of regulating the flow of the river for flood control, power and navigation.

GARRISON DAM, key unit in the Pick-Sloan comprehensive plan for the conservation of water resources of the Missouri Valley, although a rolled-earth structure, contains 1,500,000 cu yd of concrete. Hoover Dam, the world's highest dam, a concrete gravity structure, contains only slightly more than 3 million cu yd of concrete. How Garrison compares in various respects with the five largest dams in the United States can be seen from Table I.

The first stage of construction involving some 14,000,000 cu yd of fill, was carried on by a joint-venture contractor group called Garrison Builders. The present contract, covering the second-stage construction, is being carried out by Peter Kiewit Sons' Co. and Morrison-Knudsen Co., Inc. jointly. This contract includes the placing of 16,630,000 cu yd of embankment fill, or a total excavation of about 19,500,000 cu yd, and is scheduled for completion by the end of 1950. See Fig. 1.

Garrison Dam is located on the Missouri River about 12 miles south and slightly west of Garrison, N.Dak., from which it takes its name. The dam is being constructed as a multiple-purpose project for flood control, irrigation, hydroelectric power production, improved flow regulation in the interest of navigation and sanitation, recreational development and wild life preservation.

The Missouri River at the dam site drains an area of 180,940 sq miles. The reservoir created by the dam will have a capacity at maximum normal operating pool (El. 1850) of 23,000,000 acre-ft, which includes 4,900,000 acre-ft of dead storage (to El. 1775), 13,850,000 acre-ft for multiple-purpose storage (to El. 1838), and 4,250,000 acre-ft for flood control (between Els. 1838 and 1850). At minimum flood-control pool (El. 1838) the reservoir will have an area of 335,000 acres and at maximum normal operating pool (El. 1850), an area of 390,000 acres. The reservoir will extend along the Missouri River in a northern direction approximately 200 miles to within 9 miles of the mouth of the Yellowstone River, about 13 miles east of the Montana-North Dakota state line.

Upon completion the rolled-fill earth embankment will be about 12,000 ft long with the crest at El. 1875. The lowest part of the dam is 210 ft below the crest. The dam will have a crown width of 60 ft and a maximum base width in the flood plain of about 2,500 ft exclusive of the upstream impervious blanket. Embankment slopes, Fig. 2, vary

TABLE I. LARGEST DAMS IN UNITED STATES, IN ORDER OF STORAGE CAPACITY

Dam	Height Ft	Length Ft	Volume Cu yd	Storage Capacity Acre-Ft	Reservoir Area Sq Miles	Type
Hoover Dam	726	1,244	4,400,000	32,359,000	246	Gravity (concrete)
Garrison	210	12,000	68,000,000	23,000,000	609	Rolled earthfill
Fort Peck	250	21,026	128,000,000	19,417,000	383	Hydraulic fill
Grand Coulee	550	4,173	10,493,000	9,517,000	127	Gravity (concrete)
Kentucky	206	8,422	8,518,700	6,003,000	408	Gravity (concrete)
Shasta	602	3,500	8,710,000	4,493,000	46	Gravity (concrete)

CONSTRUCTION of Garrison Dam (right) continues around the clock in two 10-hour shifts, with time between shifts for maintenance of equipment and lunch periods. Flood lamps are fixed on structural steel towers 70 ft high, mounted on skids for ease in moving.

FIVE SCOOPFULS from electric shovel (right) load 25-cu yd bottom-dump truck with material excavated in spillway area. Almost all material for embankment comes from excavation. Shovel is Bucyrus 120 B and truck is butane-fueled Euclid.

from 1 on $2\frac{1}{2}$ at the top to 1 on 8 at the bottom. A highway will be constructed across the crown of the embankment.

Seepage Control and Drainage

Selected impervious material will form the upstream portion of the dam. Slope protection will consist of 3 ft of rock over 1 ft of spalls over 1 ft of bank-run gravel. This protection extends from the top of the dam to El. 1800, below which a bank-run gravel blanket will be carried down a 1 on 10 beach slope to El. 1770. The downstream portion of the dam will contain random rolled-fill material, and the exposed slopes will be protected with vegetative cover. Seepage will be controlled by an impervious blanket extending 1,250 ft upstream from the toe of the embankment and by sheetpiling and impervious-backfilled trench-cutoffs under the upstream portion of the embankment. A horizontal pervious drainage blanket under the downstream portion of the embankment, a downstream toe drain and relief wells below the downstream toe serve a similar purpose.

Flat slopes and the resulting broad base width were chosen for reasons of stability considering the 80 to 120 ft of alluvial clay and clayey glacial till which forms the foundation in the west terrace. The same broad base width will be carried across the river and east terrace to reduce seepage through the 40 to 100 ft of pervious sand forming the foundations and to provide an ample safety factor for stability. The internal section will consist of a large impervious and random embankment with a thin horizontal blanket of pervious material beneath and generally downstream of the center line to collect through seepage. The more impervious material will be placed in the impervious zone and the less impervious in the random zone. Sufficient volumes of semipervious and pervious material are available from excavated areas for use at the outer downstream portion of the random zone, which connects with the pervious drainage blanket below. This drainage blanket is 10 ft thick across the valley, decreasing to 5 ft at both abutments where the more impervious foundation and lower dam height combine to reduce seepage. Above El. 1845 the drainage blanket will be omitted entirely.

A substantially complete cutoff against foundation seepage is provided across the entire valley. Steel sheetpiling is being used for the deeper pervious strata and a cutoff trench for the shallower pervious strata. The basis for changing from a cutoff trench to sheetpiling and the location of the cutoff line were established by economic studies. For the sheetpiling a $\frac{3}{8}$-in. web, 16-in. wide section, weighing 23 lb per sq ft of wall, has been selected and has been driven without difficulty to depths of 110 ft to penetrate 8 to 10 ft into the clay till beneath the river sands.

Driving Cutoff Piling

On the east and west bank, respectively, a total of 2,398 ft and 1,412 ft of wall has been driven, and on the right bank 4,475 ft of cutoff trench

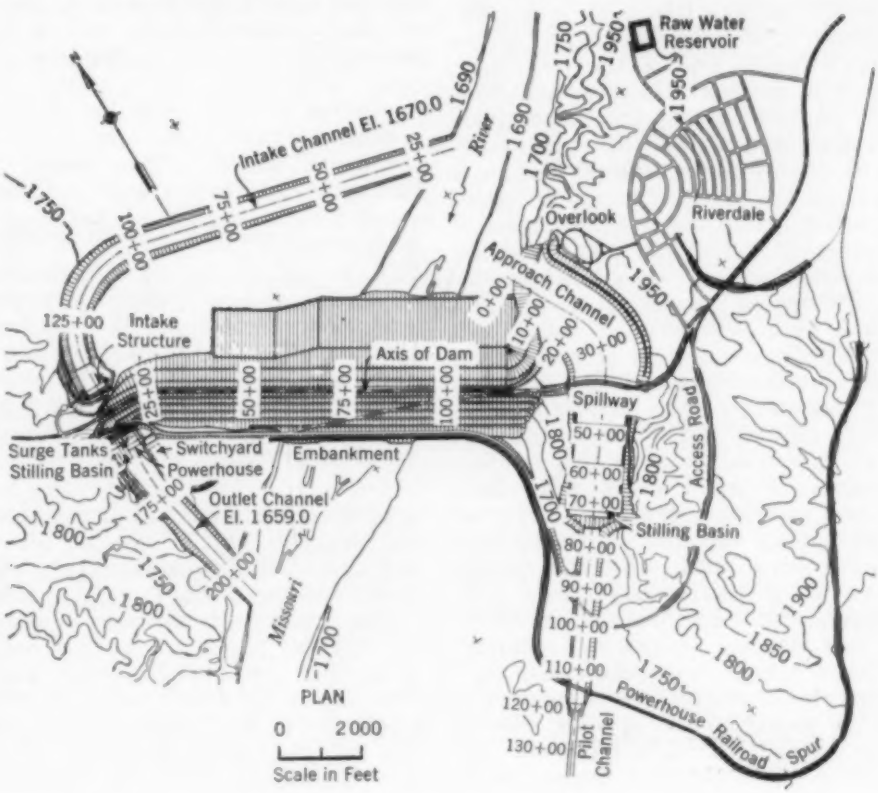


FIG. 1. PLAN OF GARRISON DAM (right) covers area of about five square miles. Channel at upper left will divert Missouri River through intake structures during diversion and closure operations in 1952. Crown width of dam is 60 ft and maximum base width in flood plain is 2,500 ft exclusive of upstream impervious blanket extending additional 1,250 ft.

TEST TUNNEL (left) completed in January 1949, at site of penstock tunnel No. 4, contains instruments to record magnitude and distribution of earth pressures. Catwalks give access to instruments and measurement points. Slots in concrete lining at invert expose sections of steel ribs for strain-gage measurements.

CRANE (above) places section of aggregate conveyor for mixing and batching plant to serve tunnels in west abutment. Refrigeration plant is also under construction here.

has been excavated and backfilled. The total length of the pile wall and cutoff trench will be 11,132 ft, including 1,580 ft driven across the present river channel. By using a leading spade jet to full depth and a hairpin jet on each side of the pile being driven, serious difficulty has been avoided in driving the deeper piles to full grade. The construction of the driving tower requires that each pile be placed and driven to full penetration before the traveling tower is advanced. This method probably necessitates a greater number of correction piles than would be required if it were possible to stick and partially drive a section of wall before driving the piling to final grade, but an advance of 30 to 35 piles, averaging 105 ft, has been maintained, which meets the scheduled requirements. Selected check piles have been pulled for inspection and none has shown damage. After the piles have been driven in their trench, and after the trench has been carefully cleaned and the muck resulting from jetting operations removed, selected impervious material is carefully hand tamped around the piles.

A blanket 1,250 ft wide extends along the upstream toe from Sta. 42 + 00 on the west terrace to the east abutment, where it will tie into the blanket covering the lignite seams in the entrance to the spillway approach channel. Varying in thickness from 14 to 24 ft where it adjoins the dam, the blanket decreases to from 5 to 14 ft at its upstream extremity. The blanket is highly impervious as compared to the underlying sands. At least 5 ft of thickness of the blanket is rolled to the same placement specifications as the impervious section of the dam; the remainder is constructed of uncompacted impervious material placed in 12-in. loose layers compacted by the traffic of placing and spreading equipment.

For conservative control of underseepage, a relief well system is planned, extending across the main reach of the deep pervious foundation from the west bank of the river to the east abutment. Present design contemplates using wood stave pipe of 8-in. inside diameter in 24-in. gravel pack wells, discharging into an open ditch approximately 175 ft downstream of the center line of the present highway which runs along the toe of the dam. The wells on the island and east terrace will be about 200 ft on centers and penetrate approximately 80 percent of the depth of the valley sands, which range from 80 to 107 ft. A drain will extend along the toe of the dam for 10,700 ft to carry through seepage from the 10-ft pervious drainage blanket and to tap the pervious sands and gravels to afford relief and drainage of under seepage from the foundation.

In the river, island and east terrace sections, the cover of the toe drain will extend down approximately 30 ft in some places, and to support this depth of cover a reinforced-concrete-encased clay pipe has been designed, employing tee branches with perforated plates to admit drainage to the pipe. To prevent movement of the silt and clay random material into the underlying pervious drainage blanket of the downstream section of the dam, a 3-ft semipervious transition layer of Fort Union sand will be used. Careful selection of material to be used in the top of the pervious blanket will prevent migration of the semipervious material into the pervious blanket.

It is expected that relatively small quantities of embankment material will be supplied from borrow pits. The excavation of the intake and intake channel, powerhouse and outlet works, and spillway will yield most of the materials needed. The haul across the river on the construction bridge is limited to the gravel and pervious materials from the intake channel excavation required in the east-bank pervious zone. Otherwise, the random and impervious materials excavated on each bank are estimated to be of sufficient volume to construct the respective embankments. Approximately 4,000,000 cu yd of commercial-grade lignite will be excavated and salvaged in the construction of the dam and appurtenant works. The exact amount to be salvaged depends on the feasibility of utilizing beds 3 ft or more in thickness.

Eight Tunnels in Right Abutment

The outlet works, located in the right abutment, consist of eight tunneled conduits, five for power and three for reservoir regulation, and an intake structure and stilling basin. The intake and outlet channels, which connect the outlet works with the river above and below the dam, average 350 ft in bottom width.

Specifications for the embankment require the contractor to spread the fill in approximately horizontal layers. All pieces of rock or lignite and cobbles greater than 6 in. in maximum dimension are removed from the impervious, random, and semipervious sections of the embankment. Pieces of rock greater than 9 in. in maximum dimension are removed from the pervious section of the embankment. Lignite is not allowed in the pervious zone. Zones of the embankment in which lignite is permitted contain no more than 2 cu ft of lignite in 10 cu ft of embankment, evenly dispersed within the layer. Because of the methods of excavation used, very little lignite has been placed in the embankment as the excavation operations generally tend to concentrate the lignite in unit loads which are wasted. Excavation operations in the thicker lignite beds, which are the exception, conform to the usual methods employed by strip mines, and all material is salvaged.

In general, the natural moisture content of the Fort Union material and overburden is satisfactory for the required compaction. Some additional water is added, and in some cases wet areas have been found in the pits which require wastage of small quantities of material. Field tests are carried on currently with the contractor's embankment work and any lift found unsatisfactory is given an additional processing by additional rolling or other remedial treatment. At times, it has been necessary to allow sections of the dam to dry either naturally or by working with special equipment. The conventional-type sheepsfoot rollers used, have a drum approximately 5 ft in diameter and weighing not less than 3,500 lb per lin ft when ballasted. Pressures of not less than 640 lbs per sq in. are exerted by the rollers.

Impervious and random material are placed in layers not over 9 in. in uncompacted thickness, and are compacted by at least ten passes of the rollers. Pervious material is placed in layers not over 12 in. in uncompacted thickness and compacted by four passes of tractor treads. Some of the Fort Union material when excavated and spread is found to be quite blocky. Specially built heavy tooth rollers of the knife or spike type are used to break down such material for compaction by standard rollers. The Fort Union material has been found quite satisfactory for the impervious section of the dam. Certain of the more sandy phases of Fort Union formation and overburden are more successfully placed in the random section.

The construction contract for the eight diversion tunnels was let in April 1949. All the tunnels will be used in the diversion and closure operations in 1952. Five of the tunnels, each 35 ft in bore diameter, are designed as penstocks, each supplying an 88,000-hp turbine, now being designed and built by the Baldwin Co. of Philadelphia. The three remaining tunnels are to be used for reservoir regulation, one being 31 ft in diameter and two 27 ft. All tunnels will be lined with 3 ft of concrete. The 1,200-ft tunnels are practically parallel, spaced 75 ft from center to center at the upstream portal. Center lines of the tunnels diverge slightly in order to increase the downstream spacing of the three reservoir control tunnels to 81 and 85 ft to allow for the economical design of the stilling basin.

In the larger power tunnels a 10 WF 72 steel rib section will be used with open lagging for about 300 ft each side of the midpoint. For the first 300 ft at both portals, 8 WF 48 steel sections will be used, also with open lagging. Rib spacing is generally $3\frac{1}{2}$ ft center to center, with 24 ft between construction joints. In the smaller control tunnels, 10 WF 49 and 8 WF 35, with the same spacing and construction details, are used respectively in the center and outside quarters. The total overburden is approximately 210 ft, of which the original ground forms approximately 120 ft, and conforms to the dam section. The full section of the dam has been completed over the tunnels and tunnel driving has been started by the contractors,

SHEETPILE WALL IS DRIVEN in sections in core trench excavation on right bank where necessary to cut off deeper pervious strata. Maximum sheetpiling length of 50 ft used here does not require tower for driving.

S. A. Healy Co. and Material Service Corp. Articulated joints will be used at the portals. The tunnels will be completed before diversion is started.

Test Tunnel on Site of Penstock No. 4

A test tunnel was built for the purpose of determining the magnitude and distribution of earth pressures to be used in designing the reinforced concrete lining and the steel ribs. The tunnel was constructed to the full diameter of the outlet works tunnels and was sufficiently long, 240 ft, to avoid arch effects and to obtain typical section loading data. Built on the center line of penstock

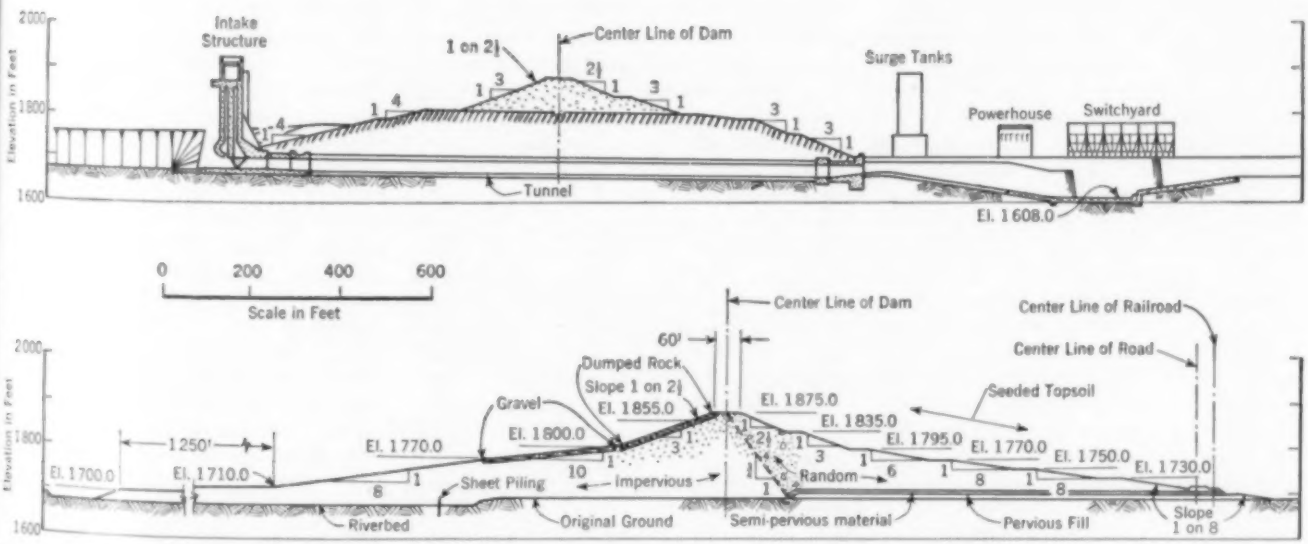


FIG. 2. PROFILE OF OUTLET WORKS (at top) indicates relative locations of intake structure, tunnels, surge tanks, powerhouse and switchyard. Maximum embankment section (below) has slopes varying from 1 on 2½ at top to 1 on 8 at bottom. Protection on upstream slope consists of 3 ft of rock over 1 ft of spalls over 1 ft of bank-run gravel from top to El. 1,800, and below, bank-run gravel to El. 1,770. Exposed downstream slopes between berms will be protected with vegetative cover.

tunnel No. 4 and completed in January 1949, the test tunnel will ultimately be incorporated as a part of the penstock tunnel. The test section is supported by circular steel rib beam sections, with spacing varying from 2 to 4 ft on centers. Of the total 240 ft only 75 ft is lined with reinforced concrete, the steel ribs being exposed throughout the remaining length of the test tunnel. The beginning of the test tunnel is 215 ft from the face of the portal excavation and access is provided by a 7×9-ft tunnel, supported with timber bracing.

Measurements Provide Design Data

Numerous strain-gage measurements on the steel ribs and on sections of ribs exposed in slits in the concrete-lined portion of the tunnel are taken, along with measurements of changes in rib diameter and shape, and soil pressure measurements from pressure cells set back of the concrete lining. Observations for supplementary data consist of the following: Carlson strain meter measurements within the concrete lining; SR-4 strain-gage measurements on reinforcing steel and rib steel within the concrete lining; direct measurements of swell of the soil mass around the periphery of the tunnel; rebound of soil strata due to tunnel excavation and excavation outside the portal; and changes in moisture content of the soil at various depths from the face of the excavated surfaces.

Experience with the test tunnel to date indicates that it is entirely feasible and safe from the construction standpoint to drive tunnels of the size contemplated in the Fort Union formation at the location selected for the outlet works. Observation for periods ranging from 9 to 11 months on the exposed ribs of the test tunnel and for about 6 months on the concrete-lined portion of the tunnel, has led to the following conclusions: Vertical loads on the exposed ribs as yet do not exceed 20 percent of the weight of overburden directly over the tunnel; horizontal loads vary from about 90 to 100 percent of the vertical loads; both vertical and horizontal loads continue to increase at slow rates, with horizontal loads approaching equality with vertical loads and thereby indicating the probability of ultimate uniformity of loading around the tunnel. The loading can be expected to attain 100 percent of the overburden over the tunnels.

Results to date have been of great value in the design of the eight outlet works tunnels, and the testing program will be continued into the first stage of tunnel construction. One of the first tunnels to be constructed will be adjacent to the test tunnel. This condition of driving a tunnel close to a previously constructed tunnel will result in the maximum unbalance of loading that can occur during the entire tunnel construction program. The data obtained from the test tunnel observations during this period will furnish an indication of the most critical condition to be considered in the design of the tunnel lining. Additional observations which will provide data for consideration in the maximum conditions of design will be available by the fall of 1949, when completion of the embankment in the west abutment section will increase the weight of overburden on the test tunnel.

Two horizontal lignite seams are intersected by the test tunnel, and continue throughout the length of the bore, with a slight dip upstream. The upper and lower seams have a thickness of 7 and 4 ft respectively. The lower seam is about 5 ft above the invert of the tunnel and the seams are separated by about the same distance. All the other material passed through is Fort Union bedrock. The test tunnel was driven by shooting the full face to a depth of 6 ft. No difficulty was encountered. Some water was found, generally concentrated in the upper lignite bed, and was cut off by grouting ahead of mining operations. This was done mainly to improve the working conditions in the tunnel. The tunnels will require 325,000 cu yd of excavation and 110,000 cu yd of concrete lining.

Intake Structure Contract Let

The intake structure, already under contract to Peter Kiewit Sons' Co. and Morrison Knudsen Co., Inc., will accommodate trash racks, stop-logs, service gates and emergency gates for the eight tunnels. The reinforced concrete substructure is approximately 170 ft in width, 540 ft in length and 200 ft in height. The five power conduits will each have two 12×26-ft vertical-lift-type service gates and, for the emergency closure of each, two 12×26-ft bulkheads will be provided. The three flood control conduits will each have one 18×24.5 ft Tainter-type regulating gate and, for emergency closure of a flood control conduit, one 18×24.5-ft vertical-lift-type emergency gate. Provisions are made for trash racks in the power conduits and stop-logs in the flood control conduits.

The substructure is surmounted by a structural steel and reinforced concrete superstructure approximately 50×50×540 ft. This superstructure will house the gate hoists, gantry crane, overhead traveling crane, power control equipment, gasoline-electric standby generator, water supply equipment, compressed air equipment, and offices. Gates, gate guides and frames, hoists, cranes and other smaller items will be furnished by the Government. Work on the intake structure, expected to be completed by February 1, 1953, includes about 100,000 cu yd of excavation, 300,000 cu yds of concrete, and 22,950,000 lb of reinforcing and structural steel.

Spillway in Left Abutment

The chute-type spillway with gates on the crest structure will be built in the left abutment with an alignment almost normal to that of the dam. To control the water entering the spillway, 28 Tainter gates 40×29 ft are to be used. The gate piers will support a bridge for the highway which will traverse the embankment. Water is conducted to the spillway by a curved approach having a bottom entrance width of 1,880 ft and a length of 3,215 ft to the gate structure. The spillway will discharge 600,000 cfs and drop the water approximately 195 ft. The crest elevation will be set at 1825 and the invert elevation of the stilling basin probably at 1636, but this elevation may be changed as a result of the model studies now under way.

A nine-span, 1,350-ft, plate-girder construction bridge has been built over the Missouri River. It carries a 26-ft roadway and a single-track railroad. During the construction period approximately 1,250,000 cu yd of pervious material from the intake channel on the right bank will be moved over this bridge to the filter zone of the dam on the left bank. Likewise all the materials for the tunnels, intake structure, powerhouse and stilling basin will pass over this bridge, which also will be used in closure operations. The superstructure is designed to facilitate dismantling and permit maximum salvage. Each span consists of three 150-ft-span plate girders, two of 75 tons and one of 50 tons for rail and highway traffic lanes respectively.

A total of 30 miles of standard-gage railroad, including classification yards and passing tracks, has been built. Rail facilities extend to the site of the major structures—the powerhouse, outlet works, and intake—and will be carried to the spillway

(*Continued on page 85*)

81ST CONGRESS
1ST SESSION

S. 2334
A BILL

To provide for the organization of the Army and the Department of the Army, and for other purposes.

~ Snafu Again ~

Army Reorganization Bills Introduced in Congress

WILLIAM N. CAREY, M. ASCE
Executive Secretary, American Society of Civil Engineers, New York, N.Y.

NO INFORMED CITIZEN will deny that there is room for improvement in the organization and functioning of our national military establishment. Present and former members of the armed forces probably would classify that as gross understatement. First steps toward over-all improvement now have been taken through the unification program, launched after years of talk and a recent report by the Hoover Commission. The legislation here discussed is not involved in the unification program or its legislation.

With a view to improvement of the Army, a faction among Army brass has developed an Army reorganization plan. This plan has no apparent relation to any part of the Hoover Commission report. It has its real beginnings during and shortly after the war. After about a year of labor by selected officers behind the closed doors of the Pentagon Building, this long-heralded Army plan was made public late this summer through the introduction of duplicate bills in both houses of Congress—S. 2334 and H.R. 5794. Senator Tydings of Maryland sponsored the bill in the Senate, and Congressman Vinson of Georgia in the House.

Several members of our Society, including the writer, have studied this bill carefully. During the past year the writer discussed this expected legislation before meetings of several Local Sections and promised more information on it when the bill became public. The ASCE Committee on Military Affairs and the Engineers Joint Council Committee on the Military Establishment have studied the bill. All condemn it. Engineers Joint Council, at its September 16, 1949, meeting, directed its committee to oppose this bill at Congressional hearings, and to attempt to make known to the engineers of the nation the true character of this legislative proposal.

Engineers, perhaps more than any other war-experienced group, have reason to feel that improvements in Army organization and functioning are desirable. However, the legislation proposed authorizes reorganization beyond recognition. It would authorize tearing down the whole house to eliminate a few squirrels in the attic.

World War II put nearly 30 percent of the members of ASCE at that time into uniform. The majority of these men served in the Army and most of them are still in, either in the Organized Reserve, National Guard or Regular Army. All engineers have a direct interest in what the Pentagon planners have cooked up, and a broader interest in what the enactment of this legislation would mean to the national defense.

The proposed legislation is said to be necessary to provide for Army flexibility, for centralization of authority and responsibility, for improving functional operations and for a better statutory base than now exists. All this sounds good. It has the persuasive and familiar ring of Washington, D.C., polysyllabic gobbledegook. The legislation would permit flexibility and centralize authority, without doubt. But it would provide for these far beyond the point of national safety or common sense. It would not necessarily result in any better Army operation functionally, and it would not provide a more stable statutory foundation on which to build the U.S. Army of the future.

While purporting to provide broad statutory foundations for a better Army organization, the proposed bill repeals most existing law prescribing Army organization, authorities and responsibilities. It sub-

TITLE III—ORGANIZATION OF THE ARMY

SEC. 301. The United States Army includes the Regular Army, the National Guard of the United States, and the Organized Reserve Corps;

SEC. 306. (a) There shall be in the Army certain branches, which shall be known as basic branches of the Army, to which members of the Army shall be assigned

There shall be
such basic branches as may from time to time be determined
to be appropriate to the development and maintenance of the
arms and supporting activities necessary to the efficiency
of the Army; and, for this purpose, the President, the
Secretary of Defense, or the Secretary of the Army may
from time to time establish new basic branches, and may
discontinue or consolidate such basic branches as are now
or may hereafter be established;

stitutes what almost amounts to no statutory foundation whatever. With the exception of three special branches, this legislation would wipe out any permanent statutory base whatever for all present branches of the Army. It would leave the organization, reorganization, consolidation and discontinuance of all but these three special branches to "the President, the Secretary of Defense or the Secretary of War."

The three branches which are left with statutory direction for the continuation of their existence are "the Army Medical Service, the Judge Advocate General's Corps, and the Chaplains." These are to be known as the "Special Branches." The balance of the Army, "the basic branches," for the present at least, are the "Infantry, Armor, Artillery, Engineer Corps, Signal Corps, Adjutant General's Corps, Quartermaster Corps, Finance Corps, Ordnance Corps, Chemical Corps, Transportation Corps, and Military Police Corps." All these are left, under the proposed law, to the future decisions of any one of the three government officials named: one elected officer and two administrative appointees. Such future decisions in the main probably would be sound. However, there is no statutory safeguard against decisions which might be inept, capricious, politically activated or otherwise dictated. This is indeed a broad statutory foundation. It is so broad that it has no depth, and appears worthless as a base for sound and needed organizational revisions of the Army.

The drafters of this legislation apparently have completely disregarded the importance of engineers and scientists in the Army. Professional status of engineers is implicitly denied in this bill, but it is sustained and maintained for the professions of medicine, law and theology. Engineers generally will favor statutory protection for the professional status of men in these "special branches," but to deny similar professional status to engineers and scientists denies many bitter lessons of World War II experience.

The technical and professional requirements for competence in engineering research, design and development are no whit less technologically demanding than the professional requirements of men in the "special branches" prescribed.

(b) There shall be in the Army certain branches, which
shall be known as special branches,
The several corps of the Army Medical Service,
the Judge Advocate General's Corps, and the Chaplains,
authorized by sections 307, 308, and 309 of this Act, shall
constitute the special branches of the Army.

Highly specialized and technical functions of the Army are involved in the fields of military engineering, research, design and experimentation in communications, transportation, military construction, subsistence, water purification, chemistry and the vast materiel of war.

Nation-wide laws and national scientific societies establish standards of qualifications for persons seeking to practice in the various technical professions in civil life. The technical services of the Army should have equally rigorous standards established by law and regulations, and should have close professional and technical relations with the corresponding civilian professions. Since the technical services must continue in some manner to be permanent organic components of the Army, statutory foundations for these specialized services appear essential to guarantee that responsibilities shall definitely be fixed and assigned functions effectively performed.

Lack of statutory retention of professional status for engineers and scientists in the Regular service would be bad enough, but it would be disastrous to any sustained interest by civilian technologists so essential to Army success in war and preparation for war. In war, the civilian engineer and scientist in uniform always makes up the bulk of the officer personnel of the technical services. Professional men in civil life, considering commissions in the National Guard or Organized Reserves, would expect and demand some assurance founded on law that they would be trained and used in the fields of their professional competence.

Should the proposed legislation be enacted, leaving no statutory provisions to maintain and improve the professional status of engineers and scientists in the Army, it is most unlikely that these civilian components will long hold many engineers now enrolled. The uncertainty and confusion which would face such men under the proposed legislation will surely discourage civilian engineers and scientists from joining these civilian components. Essential development of the civilian components of the Army, as to engineers and scientists, will be made a more difficult, if not an impossible task, if this bill passes.

The proposed bill could destroy the technical services. Until actual wartime experience demonstrates that any present technical service is superfluous or inefficient, the proposal that Congress shall delegate to a

ministrative officials full authority to "discontinue or consolidate" such branches can only be harmful and destructive to morale and to technical development. It should be noted particularly that no such delegation of authority has been requested or granted by or for the Navy. The Navy seeks to strengthen, not to weaken, all its technical services.

Flexibility in Army organization admittedly is most desirable. It also is true that military legislation can be too restrictive. However, flexibility to the extent of demoralization, which the proposed legislation permits, is not desirable. Flexibility to the degree required can and should be provided by Congress under a legislative, structural skeleton in which the general responsibilities of the several branches of the Army are delineated. This can be best accomplished through amending existing laws. Desired flexibility for the Army can be obtained, as it is now obtained for the Air Force and the Navy. It is unnecessary and unsafe, in the name of flexibility or anything else, to risk junking practically all existing law covering Army organization and departmental functions, leaving these vital essentials almost in toto to the possible uncertain decisions of some future Secretary of the Army or Secretary of Defense.

When this proposed legislation has been described before engineer groups, someone always asks, "Who wants enactment of this bill?" So far as we can determine, this legislation has been developed by a special group of officer "planners" working from the office of the Army Comptroller General. We feel almost certain that the chiefs of most or all the technical branches, including the Surgeon General, advised this planning group of their strong objection to the proposed legislation while the planners were devising it. No national engineering society was asked its views, so far as we know. The typical pattern of many such "high-level" planning groups is that the views of experts carry little weight. Apparently there was no exception in this case. The chiefs of the technical services of the Army, each an experienced expert in his own field, no longer are free on their own initiative to take their views to Congress. But Congress can, if it wishes, obtain the opinions of these officers by asking them directly.

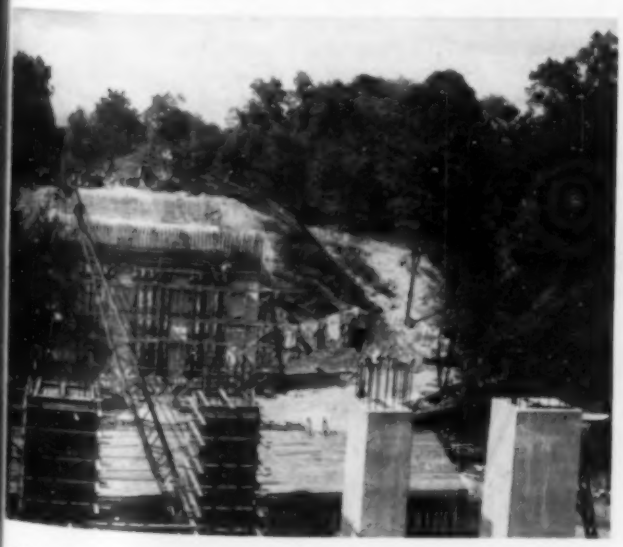
A reading of the bill by an engineer or scientist of whatever branch of technology will convince him that the proposed bill, S. 2334 and H.R. 5794, should be drastically revised, at least in so far as it covers the engineers and scientists of the Army. Both the ASCE Board of Direction and Engineers Joint Council have voiced strong disapproval of this legislation. An Army reorganization bill should be written to include by law the fundamental authorities and responsibilities of the several Army specialist corps, branches and services. Such statutes should be drawn to encourage most effectively the development and maintenance, in all three components of the Army of the United States, of the professional and scientific skills proven to be so necessary for the successful accomplishment of the mission of the Army in peace or war.

Prestressed Girder for Walnut Lane Bridge Ready for Test to Failure

Piers for Walnut Lane Bridge, Philadelphia, are now approaching completion, as shown at left below. (See E. R. Schofield's article in CIVIL ENGINEERING, July 1949.) This is the first bridge of prestressed concrete design to be built in the United States.

Each of the 13 flanged concrete girders of 160-ft main span will be prestressed by 256 high-yield-strength steel wires of ¼-in. diameter inserted in longitudinal holes precast in the bottom flange and web of the girders, which will be cast in pairs at pier level. In accordance with specifications, one main girder is being tested to failure. Photo at right below shows forms for 160-ft test girder ready for concrete (80 cu yd).

Plant-mixed concrete designed for 5,400 psi at 10 days, was poured September 21. Vibrators, both internal and external, had no difficulty in placing 2½-in.-slump concrete to which Plastcement was added at rate of 1 lb per cu yd. After concrete had taken initial set, rubber mandrels, stiffened by ½-in. pipe seen extending from end of form, were withdrawn, wire units inserted, and wires prestressed. Beam will be loaded with 500 tons of pig iron for test in latter part of October.



NARROW GORGE at upper end of Nigger Canyon forms site for Vail Dam on Temecula Creek, Southern California, midway between San Diego and Los Angeles. Steep inner walls of gorge afford good abutments for arch dam with minimum excavation.

Arch Dam Conserves Water for Vail Ranches

Constant-Angle Structure 150 Ft High to Store 50,000 Acre-Ft

EARL HAGADORN

Junior Assistant, A. L. Sonderegger, Consulting Engineer, Los Angeles, Calif.

A VALUABLE WATER conservation project has just been completed by the Vail Co. of Los Angeles, owner of the 93,000-acre Pauba and Santa Rosa Ranches in Riverside County, Southern California. By building Vail Dam, the company has utilized a fine dam site located on Temecula Creek, which is the major tributary of the Santa Margarita River. Headwaters of the river originate on Palomar Mountain, site of the 200-in. telescope, and in the Aqua Tibia Mountains, which rise to an elevation of 6,000 ft. The historical Butterfield stage trail from Arizona to Southern California, used by the Forty-niners and until the late nineties, followed Temecula Creek through the reservoir and damsite down to Pauba Ranch.

The almost ideal topography of this site makes it possible to store 50,000 acre-ft at spillway elevation. The dam is $4\frac{1}{2}$ ft thick at the top and increases to 15 ft thick at the lowest point in the foundation, where the maximum height is 150 ft. This constant-angle arch will regulate the flow of Temecula Creek over wet and dry cycles, recorded to recur every 20 to 25 years.

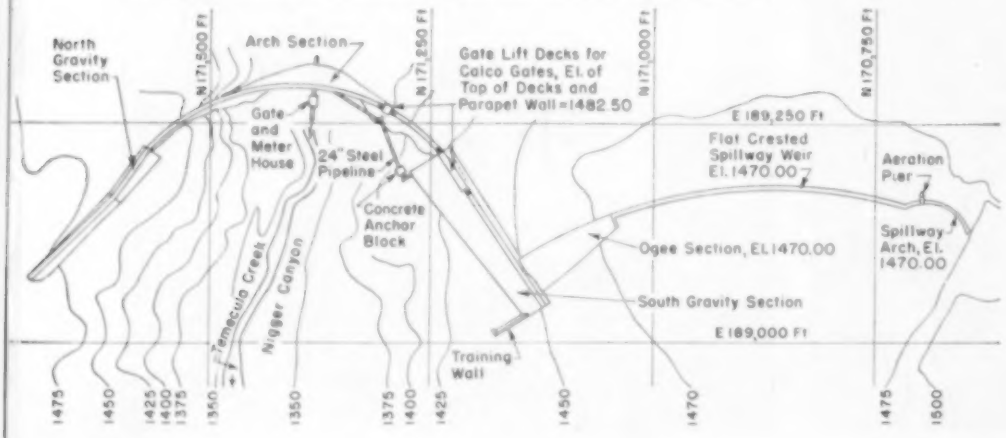
Although later investigation proved the soundness of the abutment rock, conditions unfavorable to the construction of an arch dam were at first encountered. Owing to surface decay and the fractured condition of the rock, an earthfill dam initially was believed more desirable. However, on thorough investigation of the abutments, it was found that the rock, although containing seams and small fractures, was adequate to resist the thrust of an arch dam.

An inactive minor fault was found at the base of the north abutment. The fault, 4 ft in thickness, contained weathered rock and bluish clay gouge unsuitable for water contact. Two tunnels, 12 ft apart, were dug into the fault to determine its nature. At a depth of 24 ft it was found that the seam pinched to a thickness of less than 1 ft. By filling the tunnels with concrete and pressure grouting the fault zone, the enclosed portion of the seam was sealed against excessive percolation and the bearing value improved.

Because of the excessive upstream lean at the ends of the arches, bracing walls were built to assure the stability of the dam, both during construction and when the reservoir is empty. Two at each end, the walls are 2 ft thick, and reach from 10 to 15 ft to the rock. The fractured surface rock was removed and the walls butted from 1 to 3 ft into the rock.

As shown in Fig. 1 the spillway is separate from the dam. It extends from the upstream end of the south gravity section for a distance of 520 ft, the first 125 ft of which consists of a concrete ogee section. The remainder is a combination of a 5-ft-wide flat-crested weir 330 ft long and an arch 3 ft thick. The arch, which plugs an ancient river course, is 25 ft high by 70 ft in length and has a center-line radius of 50 ft. The arch also has an aeration pier $12\frac{1}{2}$ ft high, the purpose of which is to sup-

FIG. 1. PLAN OF VAIL DAM and spillway fits structures into site on Temecula Creek, Riverside County, California. Project was completed in June 1949.



CONCRETE in south gravity abutment section is placed by 2-cu yd bottom-dump buckets carried on trucks. Trucks receive concrete from 2-cu yd mixer at compact batching plant on downstream side of dam, center foreground. Long-boom crane handles buckets from trucks to forms. Spillway site in upper middle of photo is being excavated to spillway elevation.

ply air (through a 10-in pipe) to the downstream face of the arch during overflow. This prevents a partial vacuum from being formed behind the falling water, which would suck the water against the foundation of the arch, causing excessive erosion.

With a difference in elevation of 12½ ft between the top of the dam and the spillway crest, a flood of about 72,000 cfs can be discharged. This is more than three times the maximum flood on record from the drainage area of 319 sq miles.

One of the deciding factors in favor of a concrete dam was the availability of suitable aggregate from nearby stream beds. Aggregate was screened from fine pebbles to cobbles passing a 6-in. screen. The unusually large aggregate required but 4 sacks of cement per cu yd of concrete to obtain a breaking strength of 4,000 psi in cylinders at 28 days. To overcome some initial difficulty in dumping the concrete from the 2-cu yd conical dumping bucket, after it had been trucked from the mixer and hoisted to the forms, Pozzolith was added to the cement at the rate of ¼ lb per sack.

The automatic batching and mixing plant was located 300 ft downstream from the dam some 30 ft above streambed level. The plant consisted of a 2-cu yd mixer with aggregate bins above. Incoming trucks dumped the aggregate into the bins from the top of the gorge.

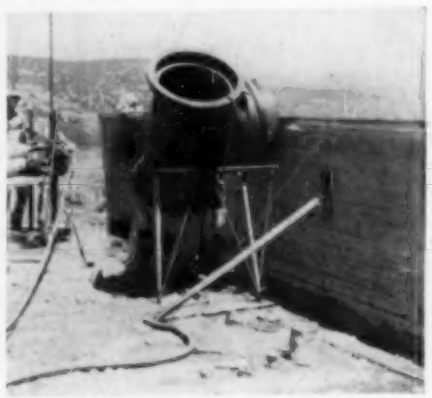
Topographic conditions and the amount of concrete to be placed—about 30,000 cu yd—favored handling the concrete by a truck and crane operation. This method was capable of placing more than 500 cu yd of concrete in a working day, and concreting was kept on schedule. Use of low-heat cement eliminated the need for any cooling system in the pours, which were 50 ft long and 5 ft deep.

An outlet from the reservoir consists of a simple 24-in.-dia pipe system, with intake openings, fitted with Calco lift gates and trash screens, every 10 ft in elevation on the upstream side of the south gravity section, and two intakes in the arch section. The lowest outlet in the arch section, which is connected to an infiltration pipe, has a gate valve on the downstream end. All outlets are connected to a common meter for recording the amount of water released into Temecula Creek.

At present water will be released into the creek below the dam to unite with the groundwater in Pauba Valley basin at the foot of Nigger Canyon, where it will replenish the wells and springs on the Pauba Ranch. Under consideration for future construction is a pipeline or flume from the dam to the Pauba Ranch irrigation system. Five months after construction, the reservoir contains over 2,000 acre-ft of water.

Consulting engineer for the Vail Co. is A. L. Sonderegger, M. ASCE, of Los Angeles. George E. Goodall, M. ASCE, designed the dam, and Kenneth J. Harrison, M. ASCE, was resident engineer.

The construction contract was let in February 1948, to the Bent Construction Co. for a bid price of $583,739. Subcontracts were let to the Continental Drilling Co., and to the Caudell and Johnson Co., for drilling and grouting, and for the aggregate respectively. The dam was completed in June 1949.



OUTLET PIPE of 24-in. diameter (at right) is one of several located in south gravity abutment. Discharge is controlled by Calco lift gates which are operated from top of abutment section. Core-drilling rig for pressure grouting of foundation appears in left background. WOODEN FORMS are placed for ogee section of spillway (below, left), which extends at right angles to south gravity abutment. (See Fig. 1.) Spillway has capacity of 72,000 cfs. ARCH SECTION OF DAM (below right) is poured in lifts 50 ft long and 5 ft deep. Height of south abutment, at right, indicates approximate final elevation of dam. View looking upstream shows wide valley above dam which will be filled by reservoir.

Has the Small-Area Flood Been Neglected?

Does It Deserve Its Own Program for Control and Abatement?

LLOYD L. HARROLD, M. ASCE

Project Supervisor, Soil Conservation Service, U.S. Department of Agriculture, Coshocton, Ohio

SMALL-AREA FLOODS have distinctive characteristics which differentiate them from large-area floods, the author states. In seasonal occurrence, character of causative rainfall, types of damage, and size of area affected, the small-area flood has its own peculiar character, a fact which should be taken into consideration in flood control work. The large-area flood is a winter menace to metropolitan centers on large rivers; the small area flood is a summer menace to cropland and causes the bulk of the soil erosion and reservoir sedimentation, Mr. Harrold finds.

ENGINEERS ARE INCLINED to think of all floods as falling into a single category, whereas in reality floods should be separated into two distinct types—large-area floods and small-area floods. Each has a fairly definite seasonal occurrence; each is caused by storms with somewhat different rainfall characteristics; and each causes a different type of damage—one to urban and the other to rural properties. The control and abatement of each type of flood is to some extent a separate problem. Leaders in state and national governments and in the industrial, engineering, and agricultural professions should keep in mind these differences in their discussions of and plans for flood control, soil and water conservation, and similar projects. Engineers cannot afford to make generalizations which neglect the basic differences between these two types of floods.

Most of the voluminous literature about floods and their control which has appeared in recent years has dealt with floods on large rivers. Numerous articles have informed the public of integrated programs for soil and water conservation and flood control of large watersheds as planned and carried out by state and federal agencies. But the small-area flood is rarely mentioned in engineering literature.

It is noteworthy that the large-area flood occurs in winter or early spring and the small-area flood comes in summer. The first is a flood in a large basin and the second is in a small drainage area. Each has a fairly definite seasonal occurrence. The seasonal distribution of maximum annual floods on a few Ohio River drainage basins ranging in size from 7.16 to 76,580 sq miles is shown in Fig. 1. It is to be noted that the small-area floods are concentrated in the summer months, at a time when only a very few floods occur in the large river basins.

The farmer knows that the summer flood in his small basin results from intense rainfall of relatively short duration—a day or less. Such rains are not very extensive; they usually cover much less than 500 sq miles. Flood peaks are great, 150 cfs per sq mile for the 7.16-sq mile basin used in Fig. 1. Elsewhere in the Ohio River basin, in a $\frac{1}{2}$-sq mile area the maximum flood observed was 1,560 cfs per sq mile, and that for an 8-acre basin was 3,000 cfs per sq mile.

Summer floods, although extremely severe for the area covered, do not produce much of a rise in the main streams of large basins. In such basins only a small part of the drainage area experiences a severe summer storm on any one day or in any one week.

On the other hand, winter storms tend to cover the entire area of a large watershed. They last for days and sometimes weeks. Rainfall intensities are usually low. Surface flow and erosion on agricultural land are not great—much less than the high runoff rates on small basins in summer storms. The combination of low rates of surface runoff from *every* square mile of a large basin and relatively high rates of groundwater flow, plus some melting of snow or ice, produces major floods on large rivers.

A study of the seasonal distribution of rainfall intensities in the Ohio River basin (Fig. 2) shows why runoff rates are great on small areas in the period from May to September. Of the annual amount of rain falling at rates greater than 1 in. per hour in the years 1940–1947, at Coshocton, Ohio, in the Ohio River Basin, 90 percent fell during the five-month growing season, as shown in Table I, which

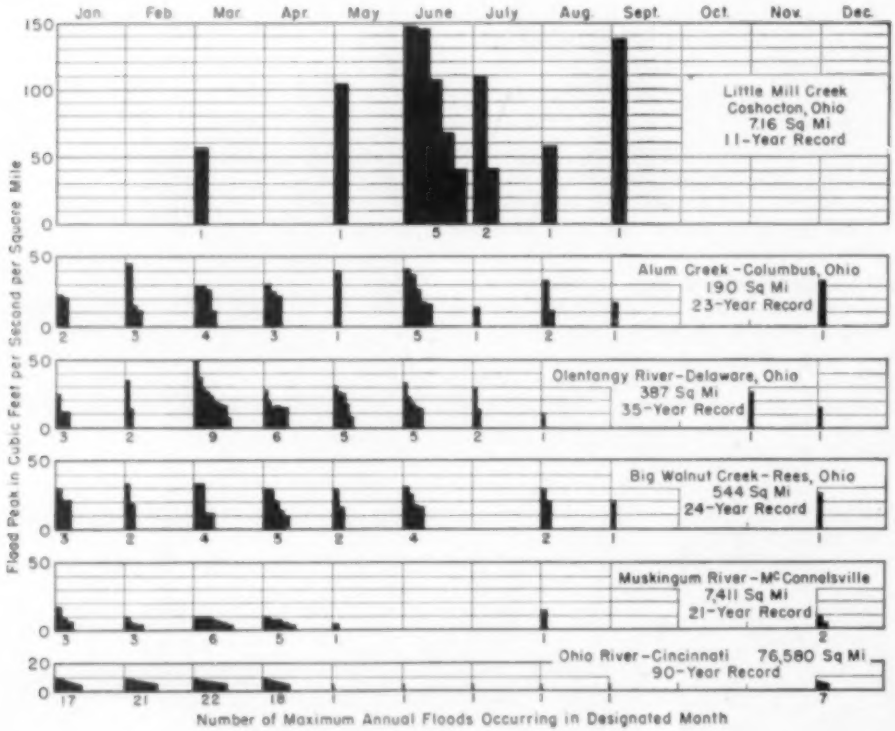


FIG. 1. TENDENCY OF LARGE-AREA FLOODS to occur in winter and of small-area floods to come in summer is shown by plotting of floods in Ohio River Basin for years of record.

LARGE-AREA FLOODS are generally winter floods which damage metropolitan areas on large rivers. Such floods are caused by storms of low rainfall intensity and long duration covering the entire area of large watersheds. Billions of dollars have been spent to control this type of flood.

SMALL-AREA FLOODS are generally summer floods which damage crops, erode valuable agricultural land, and lead to silting of reservoirs. Such floods are caused by storms of high rainfall intensity and short duration. So far little study has been given to methods of controlling floods of this type.

summarizes the data given in Fig. 2. Surface runoff and soil erosion are very great in summer months. Of the annual soil loss, 85 percent occurs in these five months.

The high velocity and turbulent flow of the small-area flood carries large quantities of soil eroded from farm land. When a small stream carrying this eroded soil enters a large river channel where the flow is slower and less turbulent, some of the suspended load is dropped. In winter, when the water in the main river flows swiftly and is more turbulent, the sediment is picked up and transported further downstream into reservoirs, lakes, and oceans. On many occasions the writer has observed winter flow from agricultural and forest land which was almost clear. Yet a hundred miles downstream, the main river was extremely muddy.

The small-area flood, although less spectacular than the large-area flood, is in many ways equally as important to the national welfare. Soil erosion, flooding of cropland, reservoir sedimentation, and destruction of or damage to bridges, culverts, drainageways, and other structures occur in many localities on a drainage basin in a single summer. Cost of such damage may equal or exceed the economic losses caused by large river-basin floods.

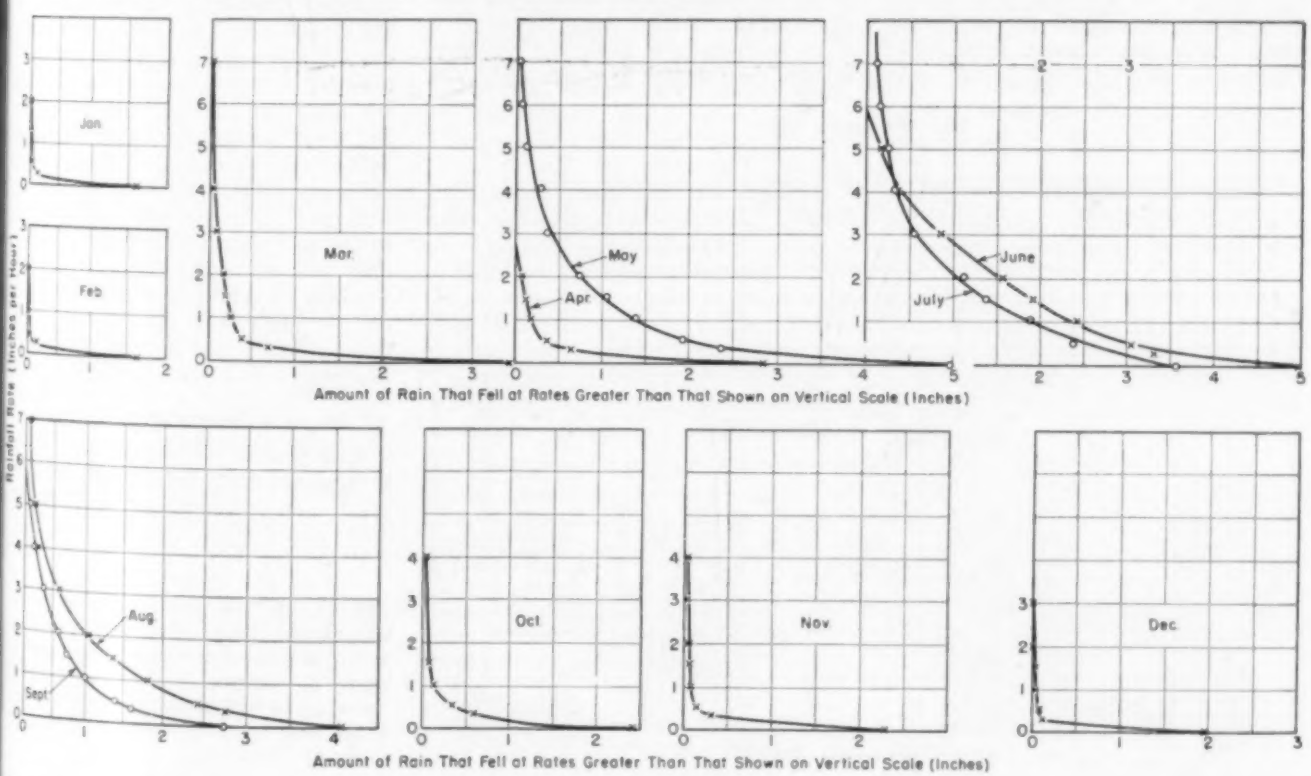
It seems evident that the small-area flood should have its own program of flood control and abatement, separate and distinct from that which has already been worked out so extensively for large drainage basins.

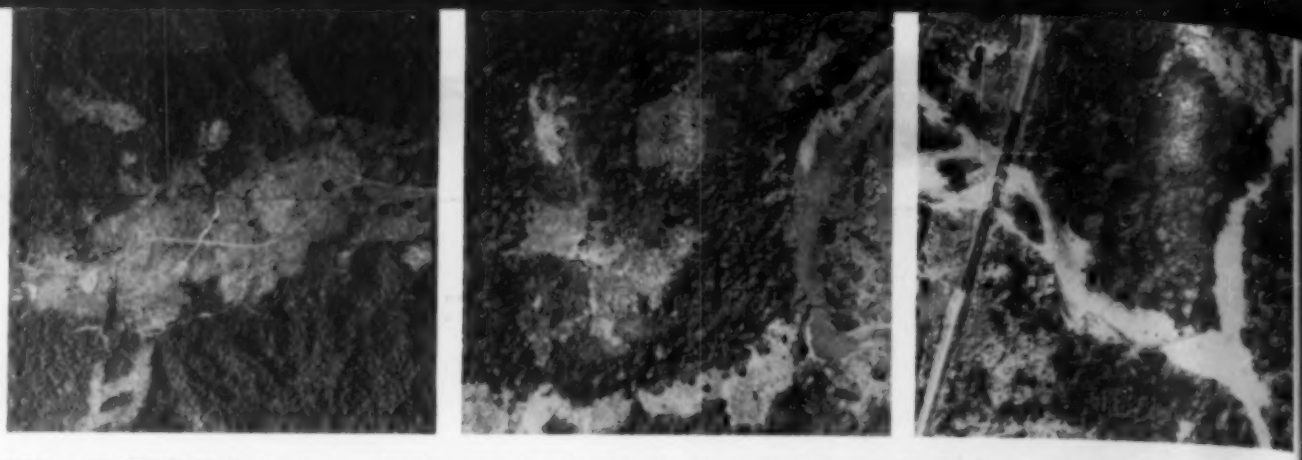
The data here given are from the Ohio River Basin.

TABLE I. INCHES OF RAIN FALLING AT RATES GREATER THAN 1 IN. PER HOUR—SUMMARIZED FROM FIG. 2

Jan.	0.1	July	1.9
Feb.	0.1	Aug.	1.8
Mar.	0.3	Sept.	0.9
Apr.	0.2	Oct.	0.2
May	1.3	Nov.	0.2
June	2.4	Dec.	0.1

FIG. 2. TENDENCY OF SUMMER RAINFALL to occur at higher intensities than winter rainfall is shown by plotting, by months of year, of average rainfall for eight years, 1940–1947, inclusive, in Ohio River Basin.





AERIAL PHOTOGRAPHS for highway location vary in scale according to purpose, topography, land use and other factors. Three photographs above, reproduced exactly to original size, illustrate scales used in rural area, where land use was not intensive. Small scale, 1:45,000 (above, left), was used for reconnaissance of wide belt between terminal points—Stage 1 of highway location procedure as described in article. Scale of 1:12,000 (center) was used for study of alternate route bands in order to determine which is preferable for highway location—Stage 2. Large scale of 1:6,000 (right) was employed for preliminary survey of chosen route line—Stage 3.

Aerial Survey Methods Solve Highway Location Problems in Tropics

WILLIAM T. PRYOR, Assoc. M. ASCE

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HIGHWAY LOCATION in tropical countries has many similarities with that in other climatic regions. From experience in the United States, Canada and Alaska as well as in Central America, the author outlines the steps required for a complete highway location by aerial methods with a discussion of the basic considerations that govern each step. He makes special reference to the tropics but the procedure outlined applies equally to other areas and the basic steps apply also to highway location without the use of aerial methods. By means of a graph and tables, specific guidance is given as to the scale of photographs and maps and the types of photogrammetric equipment best suited to a variety of specific conditions that may be encountered.

AERIAL SURVEYING METHODS have been developed to the point where they are almost universally applicable although they are particularly valuable in unmapped and inaccessible areas of the tropics.

In preparing a highway location, whether by aerial or other methods, certain initial factors must be considered and decisions made. Terminal points for the highway must be selected, keeping in mind such governing considerations as the location of seaports and ports on navigable lakes, rivers and streams. Where adequate maps of the area are not available, complete coverage by aerial photography will go far in fulfilling this need. The record of topography and land use thus provided can be studied by observing successive pairs of photographs under a stereoscope as well as by mounting the photographs in the form of a mosaic. Essential information is thus provided for use in the early stages of planning, and also for preservation as a complete record to support the decisions made as to terminal points and other features. With these photographs available for reference, misconceptions leading to wrong decisions throughout the course of the project are less likely to occur, and the skills of all the engineers working cooperatively on the project can be utilized to the full no matter how difficult the topography or the climate or how inaccessible the area.

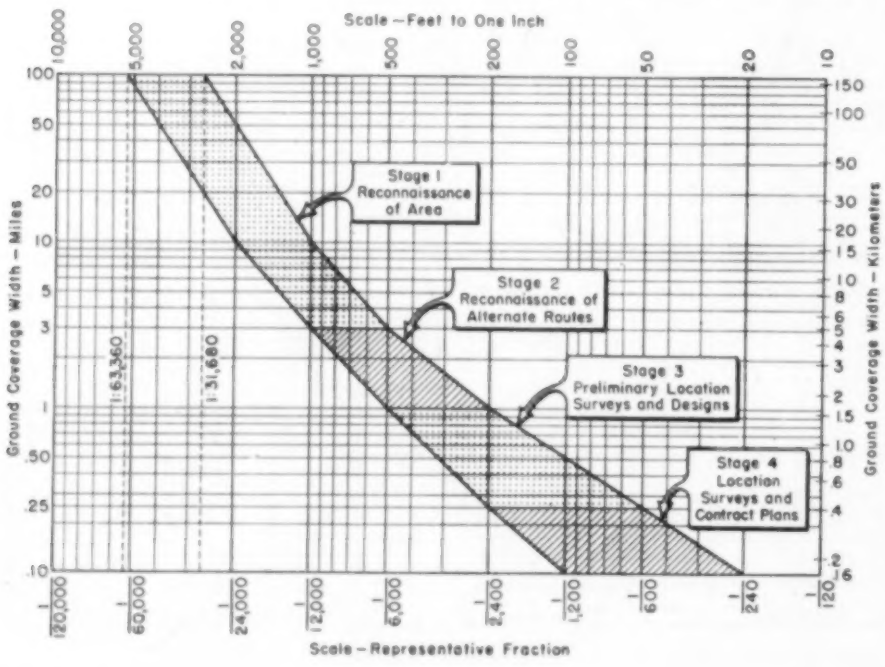


FIG. 1. SCALE for both aerial photographs and topographic maps depends on width of ground coverage desired and on stage of highway location work. Scale increases as work progresses from one stage to the next, to permit closer study of topography and land use.

Highway Characteristics Determined

After terminal points have been designated but before the location work can proceed, the dimensional

SCALES USEFUL for aerial photographs taken for highway location in urban areas, or where land use is intensive, are illustrated by three photographs, reproduced exactly to original size. Small scale of 1:22,000 (left) was used for reconnaissance survey—Stage 1 of highway location procedure as described in article. Scale of 1:12,000 (center) was employed for photographs of alternate route bands—Stage 2. Large scale of 1:4,800 (right) was utilized for preliminary survey of chosen route line—Stage 3. For range of scales for various stages in highway location procedure and for different conditions of topography and land use, see Fig. 1 and Table I.

limits or geometric standards of the proposed highway must be ascertained, such as width of roadbed and shoulders, width and number of traffic lanes and whether these lanes are to be adjoining or divided, maximum rate of profile grade, allowable horizontal curvature, and thickness of structural materials, such as subgrade and surfacing, depending on the type chosen.

If there is a large volume of motor traffic, its amount and character at the present time and as estimated for the future, together with the anticipated travel speed, are factors which influence the design. Traffic speed also sets the sight distance that will be necessary for safe passing and stopping.

Highway Location Objectives

In the entire process of locating, designing and constructing a highway two important objectives should be kept in mind: First, to reduce to a minimum the damage to or destruction of the natural topography and use of land; and second, to provide for restoration by natural means in so far as practicable and as rapidly as possible after the highway is constructed. These objectives are important for one reason—a highway cannot be built without having an effect on the topography and the land use. In virgin areas the equilibrium of forces resulting from ages of work by nature is upset when a highway is constructed. In areas where man is using the land, the highway introduces a new factor which will have a continuing effect on the use of the land. It will either advance the present use, discourage it, or change it.

The team of engineer specialists working on a highway location should always be guided by the axiom—the better the highway fits the topography by conforming with the natural forces at work in the area and the better it fits into the use of the land, the safer it will be, and the less it will cost: (1) for initial construction, (2) for vehicle operation, (3) for annual maintenance, and (4) for betterments and reconstruction, when needed. A highway should be so located that improvements can be made from time to time without relocation whenever traffic increases to such an extent that the initial construction becomes inadequate.

In tropical countries, the multiplicity of extremes encountered in climate, topography and use of land all make attainment of these objectives most desirable and particularly difficult. Yet the team of engineer specialists on the highway department's staff can accomplish these objectives easily and effectively when the modern tool—aerial surveying—is employed.

The principles of aerial surveying as applied to highway location can be resolved into two important and sometimes inseparable categories—interpretation and measurement. Measurement will be dealt with in detail later. Interpretation means the determination of the character and the relationship of the topographic features of the earth and use of land by nature and by man, and the physical, biological and cultural forces that are acting and have acted on the topography. Interpretation is a qualitative use of aerial photographs by each highway engineer specialist, who can examine them in two ways: (1) in successive pairs by use of stereoscopes, by stereophotogrammetric equipment and by the unaided eyes, as convenient; (2) singly or assembled in a mosaic.

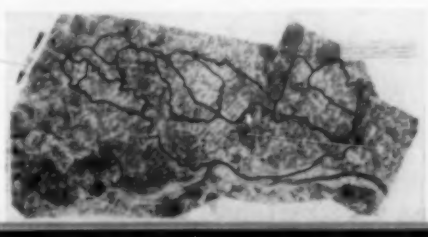
Determining the use of land by man from aerial photographs is usually not difficult. It resolves into determining the position and extent of areas used for (1) urban, (2) industrial, and (3) rural purposes, including the transportation systems and structures in each area. Rural areas may be classified as farming, grazing, timber, recreation, marginal, submarginal, waste, undeveloped and unexplored. The interpretation may include evaluation for estimating right-of-way cost, taking of land from productive use for the improvement of its use by making it accessible.

When fully interpreted the pictorial record on aerial photographs is an invaluable asset to the highway location engineer. Without the aid of such photographs, the highway engineer in tropical countries is handicapped immeasurably in obtaining essential information.

Measurement from Aerial Photographs

The second important phase of aerial surveying is measurement. Measurements for rough reconnaissance purposes can be made from aerial photographs with little or no ground-control surveying but for large-scale small-contour-interval topographic mapping, accurate ground-

FIG. 2. RECONNAISSANCE of wide area between terminal points is first stage of highway location. Mosaic of aerial photographs is studied in detail (right) and all possible highway routes through area are determined (below). Photographic mosaic, taken to small scale, serves as substitute for map to show position of alternate routes in absence of topographic maps.



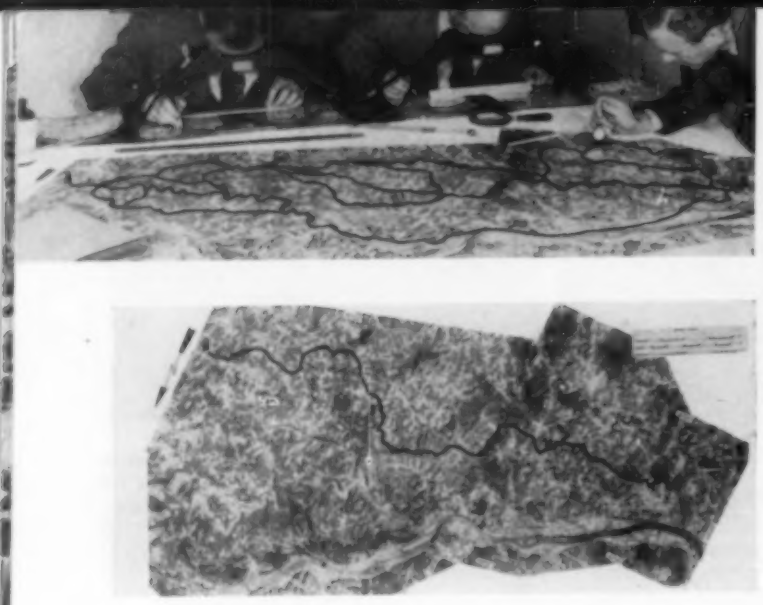


FIG. 3. DETAILED STUDY of alternate routes (top, left) and selection of best route band (lower left) is second stage of highway location. Selection is made by studying aerial photographs of each route band taken to large scale. Best route band is then drawn on photographic mosaic or topographic map. Latter is preferable if available.

control surveys must be made. Between those extremes the extent and accuracy of ground-control surveys must be governed by the stage of the highway location in which the measurements are to be used.

In aerial surveying for highway location, the least accurate measurements are made in the reconnaissance stages and the most accurate in the preliminary survey stage. Ground-control surveys to measure the position and elevation of selected indentifiable points on the aerial photographs are essential for proper orientation of the photographs in making measurements from them. The accuracy to which such ground-control surveys should be made and the number of identifiable points on the aerial photographs to be surveyed for horizontal position and elevation will depend largely on three factors: (1) The accuracy of the measurements required from the aerial photographs; (2) the method of measurement; and (3) the type and the scale of the photographs.

For horizontal control, the ground-control surveys are made by a combination of triangulation and transit-line traverse such as will best suit the topography and ground cover. For vertical control, the ground-control surveys are made by spirit levels for primary bench marks and by precise altimeters for the control of each aerial photograph.

Four Stages of Highway Location

Highway location is most effectively accomplished in four stages, coordinating results progressively attained from the reconnaissance to the location survey, as follows:

1. Reconnaissance of a wide area to determine all feasible alternate routes for the highway between terminal points, the dimensional limits (geometric standards) for the highway having been previously established.

2. Reconnaissance of alternate routes, comparing one with another to select the best route for the detailed survey.

3. Preliminary survey of the best route to determine the line for the highway on that route.

4. Location survey—the actual staking of the highway alignment, profile grade line, cross sections and structures on the ground in readiness for construction.

These stages are applicable to highway location surveys everywhere, whether made by ground surveys alone or with the aid of accurate topographic maps or with the aid of aerial surveying. The information obtained in each stage provides results which guide the work to be accomplished in the succeeding stage. Aerial surveys merely implement and improve the traditional ground-survey methods. Figure 1 will serve as a guide for choosing the best scale for photographs and topographic maps at each stage of the highway location work.

The longer the highway location project, the wider should be the area of reconnaissance. Character of topography and use of land between the designated terminal points will also have an important influence on the width of the area to be studied in each stage. In general, the width will be: (1) For reconnaissance, 40 to 60 percent of the air-line distance between the terminal points; (2) for reconnaissance of alternate routes, 1 to 3 miles (1½ to 5 km); (3) for preliminary surveys, ¼ to 1 mile (0.4 to 1½ km).

Specific widths of coverage for each stage of the highway location surveys will always be determined by the locating engineer. Shore lines of oceans, large lakes and large rivers, and rugged mountains often mark one side of the area of reconnaissance. A good rule to follow when using aerial survey methods is to obtain ample coverage. Do not attempt economy by being too conservative in widths of area photographed, mapped and studied.

First Stage—Reconnaissance of Area

The first stage in highway location is reconnaissance of a wide area to determine all feasible routes between the terminal points. The procedure is illustrated in Fig. 2. Where adequate maps of 1:100,000 to 1:25,000 scale, or aerial photographs, are not available, as is often the case in the

TABLE I. SCALE OF AERIAL PHOTOGRAPHS FOR FIRST STAGE OF HIGHWAY LOCATION

Dimensions of Area				Character of Topography	Intensity of Land Use	Scale of Photographs	
Length		Width				Representative Fraction	Feet = 1 Inch
Miles	Km	Miles	Km				
5	8	3	5	Flat	Intense	1: 6,000	500
					One Half	1: 7,200	600
					None	1: 8,400	700
				Rolling	Intense	1: 7,200	600
					One Half	1: 8,400	700
					None	1: 9,600	800
				Mountainous	One Half	1: 9,600	800
					None	1:12,000	1,000
30	50	20	30	Flat	Intense	1:15,000	1,250
					One Half	1:18,000	1,500
					None	1:21,000	1,750
				Rolling	Intense	1:18,000	1,500
					One Half	1:21,000	1,750
					None	1:24,000	2,000
				Mountainous	One Half	1:24,000	2,000
					None	1:30,000	2,500
170	270	100	150	Flat	Intense	1:30,000	2,500
					One Half	1:36,000	3,000
					None	1:42,000	3,500
				Rolling	Intense	1:36,000	3,000
					One Half	1:42,000	3,500
					None	1:48,000	4,000
				Mountainous	One Half	1:48,000	4,000
					None	1:60,000	5,000

tropics, a plan for taking the aerial photographs must be prepared without maps. The scale at which the photographs are to be taken is determined by observing the area from the air, studying all information available on topography and land use and by reference to Fig. 1.

Within the limits shown in Fig. 1, the scale should be: (1) Small wherever the topography is rugged and there is little or no development of land use; (2) large wherever the topography is not rugged and the use of land has been developed to a high degree; (3) intermediate according to the ruggedness of the topography and intensity of land use. The size of the project would have an influence on the scale at an inverse ratio, while the rule given for topography and use of land would apply directly regardless of the size. For example, the scale of vertical aerial photography selected for the first stage by use of Fig. 1 would be somewhat as listed in Table I. This tabulation is not intended to indicate a rigid demarkation of scales, but rather the range in scale of aerial photographs and topographic maps that has been found most practicable. Ordinarily, the distance between the designated terminal points for a proposed highway location shortens as the use of land by man increases, and the scale of photographs and topographic maps increases proportionately.

Choice of Focal Length of Camera

Another important point is the focal length of the aerial camera which must be chosen to conform with the type of photogrammetric equipment to be used for subsequent mapping from the aerial photographs. If stereoscopic studies and mosaics are the principal uses to be made of the aerial photographs, a long focal length is desirable. If the aerial photographs are also to be used for topographic mapping, the focal length must be chosen to suit the type of photogrammetric equipment to be used. The degree of preciseness required in the topographic maps determines the aerial camera's focal length, as listed in Table II. Aerial photographs taken with cameras of longer focal length are more easily used for many types of interpretation and for the preparation of photographic mosaics. Within practicable limits, the precision of topographic mapping is increased as the focal length of the camera is decreased, and the photogrammetric equipment is selected accordingly.

Other items besides focal length must be specified before the aerial photographs are taken. Only a few of the most important can be mentioned here: (1) Size, type and quality of material to be used for the aerial photograph and its negative; (2) type of shutter in the aerial camera; and (3) optical characteristics and precision of the aerial camera, which the National Bureau of Standards must attest to after making precision tests.

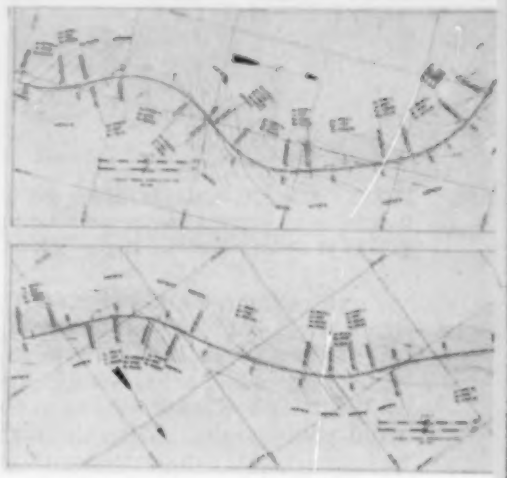


FIG. 4. CHOOSING FINAL location line of highway within "preliminary line" zone is third stage of highway location. "Preliminary line" zone is laid out on aerial photographs, a preliminary survey made of this zone on the ground, a location line projected (top right) on map of zone (lower right) from the preliminary survey, and construction quantities are computed. If ground is not hidden by heavy ground cover, topographic map can be made of route band by precise stereophotogrammetric equipment.

After the aerial photographs have been taken for the first stage of the highway location, a reconnaissance of the entire photographed area is made by carefully studying the photographs. Where topographic maps to a large enough scale and with suitable contours are not available, a mosaic is prepared from a set of the aerial photographs. Another set of the photographs is studied in pairs under stereoscopes and other reconnaissance types of photogrammetric equipment. Alternate routes are worked out on the photographs as they are studied a second time. Every dimension of the highway such as alignment, profile grade line, cross section, passing and non-passing sight distance is carefully worked out on the photographs, in combination with the use of land.

Routes Drawn on Photographs

The feasible routes are drawn by wax crayon from photograph to photograph. To show their relation to one another, the routes are also drawn on the mosaic or on adequate topographic maps, which are preferable to the mosaic if they are available. By this time the locating engineer will have obtained enough information to prepare a reconnaissance-type estimate of cost. Should

TABLE II. TYPES OF PHOTOGRAMMETRIC EQUIPMENT TO USE FOR VARIOUS PURPOSES

Focal Length of Aerial Camera		For Use in Interpretation of Topography and Land Use	For Use in Measurement, Horizontal and Vertical	
			Reconnaissance Type	Topographic Mapping
In.	Mm			
12	305	Stereoscopes for study of photographs in pairs; magnifying glasses for single photographs and for photographic mosaics	Engineers' scales on photographic mosaics, on single photographs and on pairs of photographs. Parallax measuring equipment, such as sterocomparagraph and contour finder	. . . . .
8¼	210	Same as above	Same as above and in addition, K.E.K. and Wernstedt-Mahan stereoscopic plotters	K.E.K. and Wernstedt-Mahan stereoscopic plotters; narrow-angle Kelsh plotter and Wild autograph
6*	152	Same as above	Same as above	Multiplex aeroprojectors, wide-angle Kelsh plotter, Wild autograph
5.2	132	Same as above	. . . . .	Multiplex aeroprojectors, Wild autograph
4	101	. . . . .	. . . . .	Wild autograph, Stereoplanigraph

* For topographic mapping, some government departments and commercial firms use the Stereoplanigraph converted for use of photographs taken with a 6-in. lens; in the Brock process the aerial photographs are taken with aerial cameras of 6 in. + focal length.

FIG. 5. FOURTH AND FINAL stage of highway location consists of staking on ground of location line determined in third stage. This is done using location line as projected on and computed to, coordinates of large-scale topographic map, whether map was prepared by ground or aerial methods. Highway is now ready for construction.

the cost estimate be too high for the funds available, the administrators can lower the geometric standards within reasonable limits, being guided by the wealth of information on the aerial photographs. Then the highway department can proceed with the second stage of the location work.

Second Stage—Study of Alternate Routes

The second stage is a reconnaissance of all the feasible alternate routes, comparing one with another to select the best route for the detailed survey. In this stage vertical photographs to a large scale are taken of each tentative route, using the mosaic on which the routes are shown as a flight-line chart (Fig. 2), to guide the aerial photographic crew. Thus the work accomplished in the first stage assures that the proper band of topography will be photographed for each alternate route.

The scale to which the route photographs are to be taken can be determined from Fig. 1. The smaller scales, from 1:12,000 to 1:6,000, ordinarily are used where topography is mountainous to rolling and where the use of land is not intensive. The larger scales, from 1:6,000 to 1:2,400 are used where the topography varies from rolling to gently sloping or flat and where land use is intensive.

The focal length of the aerial camera, its precision, etc., are determined by considering: (1) whether topographic mapping by use of the route photographs is to follow; (2) what type of photogrammetric equipment is available for the mapping; and (3) what the contour interval and scale of the topographic maps is to be. If topographic mapping by photogrammetric methods is not practicable, photographs taken with long focal-length aerial cameras are preferable for mosaics and for stereoscopic study, particularly in metropolitan areas and where topography is rugged.

If topographic mapping for the third stage by use of the aerail photographs is contemplated, the more precise types of stereophotogrammetric equipment must be used, such as the Multiplex Aeroprojector, the wide-angle Kelsh Plotter, the Wild Autograph or the Stereoplanigraph.

After the route photographs have been taken they are studied thoroughly by the highway location engineer and all other engineers on the team cooperating in the highway location work. The procedure is exemplified in Fig. 3. Stereoscopes are used for interpretation purposes and reconnaissance-type photogrammetric equipment for making essential horizontal and vertical measurements of the topography. Each of the feasible alternate routes is studied mile by mile and a route band of topography is outlined on the photographs. This work is accomplished in sufficient detail to permit rating of each alternate route for: directness to avoid unnecessary length between terminal points; fitting the highway into the topography and use of land along the way by attainable alignment (horizontal curvature and joining tangents, including sight distances), profile grade line, cross sections, drainage structures, bridges and other structures; scenic and esthetic features improved or destroyed; immediate and continuing benefits to present and potential use of the land in the region; benefits to populations and service to traffic; opening up of areas or regions rich in natural resources; possibilities and estimated cost of future improvement when traffic increases; anticipated annual cost of maintenance; quality, amount and accessibility of available local materials for highway construction; character and condition of rock and soils; drainage areas and drainage conditions; character of bridge sites and number and cost of structures; volume of excavation and embankment in relation to erosion; highway maintenance and betterment costs and possible hazards to traffic; connections to other highways or roads; highway and railroad separation structures; destruction of, or taking out of service of, land in use for habitations, farming and so on; right-of-way costs and land damage claims; and other factors peculiar to the region through which the route passes.

Next the route determined to be the best for the highway on the basis of all points studied is carefully drawn on the mosaic or map prepared for the first stage. The location engineer is now prepared to proceed with the third stage, which is the preliminary survey of the best route to determine the exact location of the highway on that route. This means making accurate measurements of: (1) topography, (2) position and boundaries of all property affected and (3) character of topography and land use.

Third Stage—Preliminary Survey and Design

The preliminary survey (Fig. 4) can be made by either ground or aerial methods, depending on several factors, among them the following:

1. Character of topography and intensity of land use.
2. Time allowed for completion.
3. Funds available.
4. Stereophotogrammetric equipment available or the possibility of contracting the work to a well-qualified commercial firm.
5. Type and density of ground cover.

The first four of the above factors are of an administrative character,

(*Continued on page 81*)

Engineers' Notebook

Formulas Indicate Earthquake Forces in Design of Ring-Girder-Supported Pipes

H. ALDEN FOSTER, M. ASCE
Principal Associate, Parsons, Brinckerhoff, Hall, & Macdonald, New York, N.Y.

FORMULAS for the design of ring-girder-supported pipes, supported by vertical reactions, applied at points which are not located on the horizontal axis, were presented by the writer in a previous article, published in CIVIL ENGINEERING for September 1949. These formulas resulted from a development of the studies originally presented by Herman Schorer, M. ASCE, in 1933 ("Design of Large Pipe Lines," TRANSACTIONS of ASCE, Vol. 98 (1933), p. 101). The present article gives formulas for computing the moments and stresses in the ring girder when the pipe is supported at points on the horizontal axis, but subject to transverse forces produced by horizontal acceleration resulting from an earthquake.

A cross section of the pipe at the stiffening ring, which indicates the external forces acting on the ring, is given in Fig. 1, in which

Q_e = total horizontal reaction of pipe supports, transmitting earthquake acceleration to pipe

V_e = vertical reaction of supports, due to earthquake overturning moments

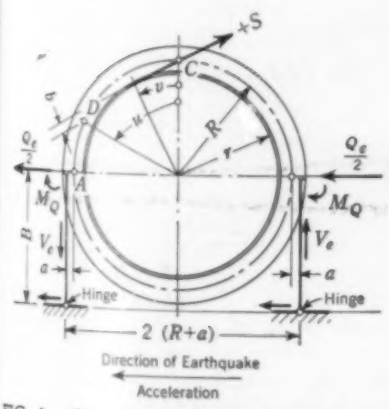


FIG. 1. CROSS SECTION of pipeline at ring girder shows external forces acting on girder by horizontal acceleration due to an earthquake. Ring girder is supported at points on horizontal axis.

K_e = earthquake coefficient
= ratio of earthquake acceleration to acceleration of gravity

P_e = water pressure in pipe, due to earthquake acceleration

M_q = bending moment applied to stiffening ring at point where vertical supporting post is attached

S = unit tangential shearing force transmitted to stiffening ring

q = unit weight of fluid in pipe

Q = total vertical load of pipe transmitted by shear to one supporting ring

Loading on the ring, assuming the ring to be cut at the top, point C, is shown in Fig. 2. The forces x_1 and y_2 and the moment M_z are applied as shown at the axis to hold the ring in position.

The radial unit pressure of the fluid on the shell of the pipe is

$$P_e = -K_e qr\,(1 - \sin U) \quad \ldots\ldots(1)$$

$$V_e = Q_e \frac{B}{2(R+a)} \qquad M_q = Q_e \frac{B}{2}$$

$$Q_e = K_e Q$$

Hence,

$$Q_e = K_e \pi r^2 q (L/2) \quad \ldots\ldots(2)$$

in which L = span of pipe between supports.

Stresses in Supporting Ring

The unit tangential shear transmitted to one ring is

$$S = K_e qr(L/2)\cos U = \frac{Q_e \cos U}{\pi r} \quad \ldots\ldots(3)$$

The moment at any point in the ring due to shearing forces is

$$M_s = -\frac{Q_e R}{\pi}\left[\frac{U\cos U}{2} - \sin U\left(\frac{r}{R} - \frac{1}{2}\right)\right] \quad \ldots\ldots(4)$$

It can be shown that the assumed force $x_1 = 0$.

The assumed force

$$y_1 = \frac{Q_e}{\pi}\left[\frac{r}{R} - \frac{3}{4} + \frac{B\pi}{4(R+a)}\right] \quad \ldots\ldots(5)$$

The assumed moment, $M_z = 0$.

Using these values of x_1, y_1 and M_z, the following formulas can be obtained:

Moment at top of ring is

$$M_0 = M_z - Rx_1 = 0$$

Normal force at top of ring is

$$N_0 = x_1 = 0$$

Moment in ring at any point in the first quadrant is

$$M_1 = \frac{Q_e R}{4\pi}\left[\sin U\left(1 - \frac{B\pi}{R+a}\right) - 2U\cos U\right] \quad \ldots\ldots(6)$$

Maximum value of M_1 occurs at the angle U satisfying the equation,

$$U\tan U = \frac{1}{2} + \frac{B\pi}{2(R+a)} \quad \ldots\ldots(7)$$

The moment at A, above the support, is

$$M_{a1} = \frac{Q_e R}{4\pi}\left(1 - \frac{B\pi}{R+a}\right) \quad \ldots\ldots(8)$$

The moment at A, below the support, is

$$M_{a2} = \frac{Q_e R}{4\pi}\left(1 + \frac{B\pi}{R+a}\right) \quad \ldots\ldots(9)$$

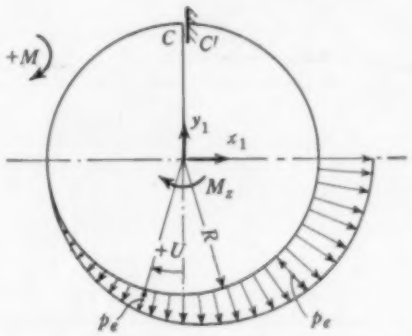


FIG. 2. CROSS SECTION of ring girder shows loading caused by horizontal earthquake forces, assuming ring to be cut at top (for purposes of analysis) and supported at points on horizontal axis.

The normal force at the support is

$$N_a = \frac{Q_e}{\pi}\left[\frac{r}{R} - \frac{1}{4} + \frac{B\pi}{4(R+a)}\right] \quad \ldots (10)$$

It should be noted that, because of the reversal of the earthquake acceleration, all these values of moments, thrusts and shears are reversible.

The stresses in the ring girder and in the pipe shell which are caused by earthquake acceleration should be combined with the corresponding stresses due to the vertical loads from the weight of the loaded pipe and to the internal water pressure.

Because of space limitations, the detailed derivations of the formulas presented here are omitted, but they may be obtained on request to the writer.

This analysis of earthquake forces on the ring girder was developed by the writer in connection with the design of a surge tank for La Insula Power Plant of La Central Hidroelectrica de Caldas, at Manizales, Colombia. Seismic conditions existing in the Andes Mountains of Colombia made it necessary to provide adequate strength and stability against earthquake forces on the tank. Because of unfavorable foundation conditions, the tank was finally designed as a pipe sloping up the hillside, with ring-girder supports. Using an earthquake coefficient of one-eighth of gravity, it was found that the unit stress in the ring girder resulting from earthquake acceleration amounted to about 30 percent of the stress at the same point due to vertical loads only (see *Engineering News-Record*, Nov. 11, 1948).

The writer wishes to acknowledge the assistance of Sergey Steuerman in checking the mathematical development of the formulas here given.

... THE READERS Write

European Texts Give Solution for Trapezoidal Loading on Beams

To the Editor: In an article on the computation of fixed end moments of beams with trapezoidal loading, in the July issue of Civil Engineering, Elihu Geer, M. ASCE, stated that such formulas have not been published before in textbooks.

While such formulas may not readily be found in American publications, they had been presented in European books. The following table is based on Kleinlogel's *Der Durchlaufende Traeger* and *Belastungsglieder*. Applying Mr. Geer's diagram and nomenclature, the fixed end moments M_{Fab} and M_{Fba} are given by multiplying $q \times L^2$ by the coefficient from Table I. These coefficients are based on the ratio c/L.

TABLE I. COMPARISON OF COEFFICIENTS OF c/L

c/L	Coefficient	c/L	Coefficient	c/L	Coefficient
0.00	0.0833	0.20	0.0773	0.40	0.0620
0.01	0.0833	0.21	0.0767	0.41	0.0611
0.02	0.0833	0.22	0.0761	0.42	0.0601
0.03	0.0832	0.23	0.0755	0.43	0.0591
0.04	0.0831	0.24	0.0749	0.44	0.0581
0.05	0.0829	0.25	0.0742	0.45	0.0571
0.06	0.0827	0.26	0.0735	0.46	0.0561
0.07	0.0825	0.27	0.0728	0.47	0.0551
0.08	0.0823	0.28	0.0721	0.48	0.0541
0.09	0.0820	0.29	0.0714	0.49	0.0531
0.10	0.0817	0.30	0.0706	0.50	0.0520
0.11	0.0814	0.31	0.0698		
0.12	0.0811	0.32	0.0690		
0.13	0.0807	0.33	0.0682		
0.14	0.0803	0.34	0.0674		
0.15	0.0799	0.35	0.0665		
0.16	0.0794	0.36	0.0656		
0.17	0.0789	0.37	0.0647		
0.18	0.0784	0.38	0.0638		
0.19	0.0779	0.39	0.0629		

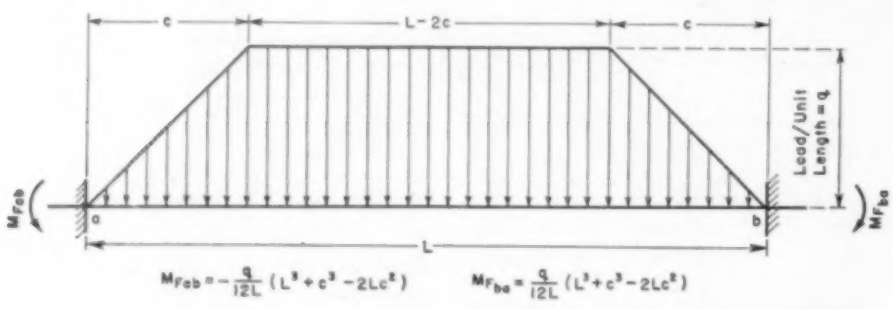


FIG. 1. $M_{Fab} = M_{Fba} = q \times L^2 \times$ coefficient.

Paul Rogers, M. ASCE
Structural Engineer
Chicago, Ill.

(*Editor's Note:* A letter from John Makaretz, of Brookline, Mass., calls attention to the same German text.)

Member Honored for Work on Mississippi Stabilization

Dear Sir: In the "News of Engineers" item on page 72 of the July issue, concerning "Exceptional Civilian Service Award," which was presented to the writer, omission of the word "underwater" renders the statement incongruous. The basis for the award was: demonstration of the feasibility of underwater placement of masses of sand-asphalt mixtures by gravity to congeal as erosion-resistant structures on subaqueous banks. Such underwater placement is a recent development in operations for stabilization of the Mississippi River.

Rossiter M. McCrone, M. ASCE
Vicksburg, Miss.

SOCIETY NEWS

Local Sections in District 9 Meet to Form Council

OFFICERS AND MEMBERS of the ASCE from seven of the eight Local Sections comprising District 9 met at Clifty Inn in Clifty Falls State Park, Ind., on September 18, to discuss formation of a District Council. The meeting of Section officers was called by Dean D. V. Terrell, Society Director from District 9, in conjunction with the two-day annual joint meeting of the Kentucky and Indiana Sections. Dean Terrell acted as temporary chairman of the proposed Council and will continue to serve in that capacity until a constitution and by-laws can be drawn up and acted upon by the separate Sections.

With the main objective of promoting closer relationship among Sections having a community of interests, the proposed District Council will be somewhat similar in form to other Local Section groups that have united for cooperative action during the past two years—the California, Pacific Northwest, and District 10 Conferences. Another important objective of the proposed District 9 Council will be to bridge the gap between the Board of Direction and the Sections, and plans were tentatively made to hold a Council meeting each year sufficiently in advance of the ASCE Annual meeting so that Society officers from the District can be fully informed of the wishes of the Sections they represent.

In an address on "European Underground Hydroelectric Plants," which was one of the highlights of the weekend, Gail A. Hathaway, special assistant to the Army Chief of Engineers, stated that some organizations and agencies in this country are giving serious thought to the subject of building underground utility structures here to avert possible bomb damage. His talk was illustrated by colored slides of dam and power installations throughout the continent, which showed varying degrees of bomb damage. Last year Mr. Hathaway made a tour of bombed construction projects in continental Europe, which was arranged for delegates attending the first International Congress on Large Dams in Stockholm. Mr. Hathaway was one of the Society's representatives to the conference.

Located on the bluffs of the Ohio River, the Clifty Falls State Park provided a

SOCIETY AND SECTION OFFICIALS ATTENDING CLIFTY FALLS MEETING include (lower photo, left to right) C. C. Walker, director and past-president, Central Ohio Section; A. D. Yanda, secretary, Cleveland Section; Clarence Bowser, president, Central Ohio Section; K. B. Woods, secretary-treasurer, Indiana Section; J. H. Clark, corresponding secretary, Kentucky Section; ASCE Director-elect G. Brooks Earnest, Cleveland; M. P. Lauer, president, Akron Section; C. L. Cowan, secretary, Kentucky Section; D. V. Terrell, ASCE Director, District 9; C. R. Dole, secretary, Dayton Section; F. F. Schrader, president, Kentucky Section; E. L. Chandler, ASCE Assistant Secretary, New York Office; Gail Hathaway, former Vice-President, Zone II; B. A. Poole, president, Indiana Section; and R. B. Wiley, former Vice-President, Zone III. In upper view, Former Vice-President Gail Hathaway answers questions of enthusiastic audience that heard his talk on "European Underground Hydroelectric Plants."

beautiful setting for the weekend joint meeting, which was attended by over 100 engineers and their families. The Indiana and Kentucky Sections have held annual joint meetings since the fall of 1947, and this year the Kentucky Section was host to the group. Officers were present from all Sections in the District except Toledo. The attendance also included former ASCE Vice-President R. B. Wiley, Director-Elect G. Brooks Earnest, and Assistant Secretary E. L. Chandler, in addition to Director Terrell and former Vice-President Hathaway.

EJC Considers Affiliation with UPADI

THE PROVISIONAL CONSTITUTION of the proposed Pan-American Union of Engineering Societies (UPADI) was considered at the September 16 meeting of Engineers Joint Council and referred to the EJC Committee on International Relations for study and recommendation. Formulated at the Sao Paulo Conference in July, the UPADI constitution must be ratified by 15 countries through their engineering federations before it is adopted.

With the aim of unifying the profession in the western hemisphere and providing an organization to work with UNESCO and the United Nations, the proposed UPADI will encourage the holding of Pan-American conventions and promote cultural and social exchanges among the various countries represented. Dean S. S. Steinberg, M. ASCE, of the University of Maryland, represented EJC at the Sao Paulo Conference.

Procedures for increasing the unity of the profession in this country also came up for discussion at the EJC meeting, which approved the program prepared by the EJC Committee on Increased Unity of the Engineering Profession. ASCE Past-President Malcolm Pirnie represents the Society on the committee, which is headed by H. S. Osborne. ASCE Past-President R. E. Dougherty, president of EJC, will preside at an exploratory meeting to consider further ways of increasing professional unity, sponsored by the committee, to be held at Society Headquarters on October 20.

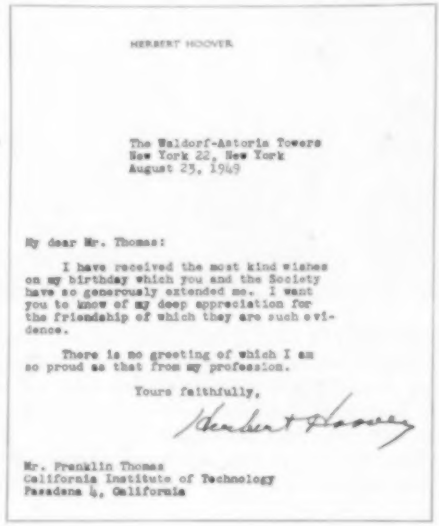
To date 16 engineering societies have signified their intention of sending representatives to the exploratory meeting. In addition to the five constituent societies of EJC, these are the American Society for Engineering Education, the American Society of Heating and Ventilating Engineers, the American Society of Refrigeration Engineers, the American Water Works Association, the Illuminating Engineering Society, the Institute of Aeronautical Sciences, the Institute of Radio Engineers, the National Society of Professional Engineers, the Society of Automotive Engineers, the Society of Naval Architects and Marine Engineers, and the American Association of Engineers. As chairman of the Committee on Inter-Society Cooperation, Enoch R. Needles has been designated to represent ASCE at the exploratory meeting.

HARLAND C. WOODS, OF BUFFALO, N.Y., who will soon complete three-year term as ASCE Director from District 3, is retiring on October 1 as head engineer of Buffalo District of Corps of Engineers. In the Buffalo Office of the U.S. Engineer Department since 1929, Mr. Woods has been engaged in river and harbor, flood control, beach erosion, and other work in the District. He expects to make his home in Orlando, Fla. Honors accorded Mr. Woods include a testimonial luncheon given him by the Buffalo Section of ASCE, and an editorial in "The Buffalo Evening News" hailing him as "a fine exemplar of the best traditions in public service."

Herbert Hoover Responds to ASCE Congratulations

ASCE PRESIDENT FRANKLIN THOMAS wrote Herbert Hoover, Honorary Member of the Society and only living Past-President of the United States, expressing the congratulations and good wishes of the Society upon the occasion of his recent 75th birthday celebration. Mr. Hoover's anniversary was observed by a program in the Stanford University amphitheater (photo, page 52), to which notables came from all over the United States, followed by his broadcast over a nation-wide hook-up.

President Thomas' letter, which was one of many thousands received by Mr. Hoover from friends and well wishers, offered "hearty congratulations on the occasion of your seventy-fifth birthday and best wishes for many more years in which you may continue to render outstanding service to our country." He concluded, "As the most distinguished Honorary Member of our Society, we send you our greeting with both pleasure and pride." Mr. Hoover's reply, expressing his pride in greetings from his profession, is printed here in facsimile.



HERBERT HOOVER

The Waldorf-Astoria Towers
New York 22, New York
August 25, 1949

My dear Mr. Thomas:

I have received the most kind wishes on my birthday which you and the Society have so generously extended me. I want you to know of my deep appreciation for the friendship of which they are such evidence.

There is no greeting of which I am so proud as that from my profession.

Yours faithfully,

Herbert Hoover

Mr. Franklin Thomas
California Institute of Technology
Pasadena 4, California

Book Loan Rates Are Reduced by E. S. Library

A REDUCTION IN book loan rates to members of the Founder Societies has been authorized by the Engineering Societies Library, according to an announcement from Ralph H. Phelps, director. This reduction lowers the charge for each volume borrowed from 60 to 50 cents a week. Members will now be able to send a dollar bill for a two-week loan on one book or a one-week loan on two books, when the material is returned. Payment by this method is urged, as it helps to keep loan charges low by eliminating billing costs. Charges cover only handling costs, including wrapping, postage, and insurance. Return postage and insurance must be paid by the borrower. Members in Canada also pay forwarding postage.

The procedure is made as simple as possible. Members not able to make their requests in person should write, stating their membership affiliation and being as explicit as possible about the material desired. As many as three volumes may be obtained on loan at one time. The maximum length of time for any loan is two weeks, exclusive of time in transit.

Requests should be addressed to the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

ASCE Fall Meeting in Washington, D.C., Offers Challenging Program

ALL PHASES OF the multiple interests of the profession will be served by the program of the Society's Fall Meeting, to which the District of Columbia Section will be host in Washington, D.C., November 2–4. Talks will range from the engineer's role in the economic and technical rehabilitation of war-damaged countries to technical problems arising in the construction of local projects. In addition to unusual opportunities for sightseeing and tours, arrangements have been made for inspection of many postwar construction projects in Washington and its Maryland and Virginia environs.

By a fortunate coincidence, work on both the White House and Capitol reconstruction projects will be under way at the time of the Fall Meeting. Other projects that engineers will want to see include the drawbridges under construction across the Potomac and Anacostia rivers; the elaborate new highway network serving the capital area; the Washington Airport; and the Blue Plains sewage treatment plant.

Tours of Federal Agencies Planned

An opportunity to study recent changes in surveying and mapping techniques will be provided by tours of a number of federal mapping agencies. Organizations that have arranged for inspection of their mapping facilities include the U.S. Geological Survey, the Army Map Service, the Coast and Geodetic Survey, the U.S. Forest Service, and the Navy Hydrographic Office. New photogrammetric and electronic instruments, as well as new methods of map compilation and reproduction, may be observed on these trips. Other tours of government laboratories will take in the Naval Ordnance Laboratory at White Oak, Md., and the David Taylor Model Basin.

Tours Open to Student Chapter Members

Members of Student Chapters in the eastern part of the country are reminded that inspection of the engineering offices of the various government agencies will be an important part of the program of the Student Chapter Conference, which is scheduled for November 1. The conference date was set in advance of the Fall Meeting to permit attendance of students at its technical sessions and social events. Special arrangements have been made for the housing and entertainment of students during their Washington visit.

Technical Divisions to Discuss Timely Topics

The role of the American engineer in the "rapid development of .the undeveloped areas of the world" will be stressed by Willard L. Thorp, Assistant Secretary of State, in a leading talk sponsored by the Construction Division. Mr. Thorp will outline the President's Point Four Program and show how its objectives can be reached only through the widespread use of modern technical methods and the expansion of our productive facilities. Another talk of wide interest will be W. E. Reynolds' description of the White House renovation project, which will be presented before the Structural Division. "Sins of omission" in the building of the White House, and in subsequent work on it will be explained by Mr. Reynolds, Commissioner of Public Buildings, as background material for a description of

WASHINGTON CONSTRUCTION PROJECTS NOW UNDER WAY that will be objective of Fall Meeting tours include (top photo, left) bascule span of 14th Street Bridge across Potomac (photo courtesy of District of Columbia Highway Planning Survey); Whitehurst Freeway intersection with Key Bridge over Potomac (lower left); and (lower right) South Capitol Street Bridge across Anacostia River, showing swing span erected in open position (photo courtesy Bureau of Public Roads).

the present reconstruction project. The White House has undergone major rehabilitation work three times since its completion 140 years ago.

Other Technical Divisions scheduling sessions are the Hydraulics, City Planning, Surveying and Mapping, Power, Air Transport, Sanitary Engineering, Highway, and Waterways. The full program of speakers and their papers was published in the September issue.

The principal address at the Wednesday morning general session will be by Maj. Gen. Lucius D. Clay, commanding general of the U.S. Military Government in Germany until his recent retirement from active service. General Clay's subject will be "The Engineer Looks at Europe."

Numerous Social Events Scheduled

Details of the many social events, of the special entertainment for women visitors, and of the post-convention excursion into scenic and historic Virginia are also given in the program. A hearty welcome to take part in all the Fall Meeting activities is extended by the host Section, through its president Byron Bird, and its general arrangements chairman, Archie N. Carter.

Headquarters at Hotel Statler

Registration for the ASCE Fall Meeting will be at the Hotel Statler, meeting headquarters. To accommodate those arriving early, the registration desk will open Tuesday morning, November 1. All inquiries about accommodations should be addressed to: Mr. Vincent B. Smith, chairman, ASCE Hotel Committee, c/o Sales Department, Hotel Statler, Washington, D.C.

Joseph C. Kent Awarded J. Waldo Smith Prize

THIS YEAR'S WINNER of the J. Waldo Smith Hydraulic Fellowship is Joseph C. Kent, Jun. ASCE, of Berkeley, Calif., who will make an extensive study of flow in pipes at the University of California during the 1949–1950 academic year.

Joseph C. Kent

A Canadian by birth, Mr. Kent graduated from the University of British Columbia in 1945, with the degree of bachelor of science in civil engineering, and was awarded first prize for a paper, "Specification on Timber Preservation," in a university contest. After two years of work in the Hydrographic Branch of the Canadian Department of Mines and Resources, he studied hydraulics at Stanford University, receiving a master's degree in civil engineering in 1948. Since then Mr. Kent has been working in the Hydraulics Department at the University of California and doing research for the Beach Erosion Board there.

Endowed in 1938 by a bequest to the Society of the late J. Waldo Smith, Hon. M. ASCE, the J. Waldo Smith Fellowship currently carries a cash award of $1,000, plus an allowance of $400 for equipment. It stresses practical research in the field of experimental hydraulics rather than purely theoretical hydraulics.

Committee on Hydrology Suggests Reading in Field

RECENT HYDROLOGIC LITERATURE of professional value has been reviewed for CIVIL ENGINEERING by special subcommittees of the Society's Committee on Hydrology. Only material that has been published since the writing of the ASCE Manual of Hydrology (announced in the August issue, page 53), appears on the Committee's list, which is summarized here.

Precipitation References

1. **The Use of Radar in Determining the Amount of Rain Falling Over a Small Area.** By Horace R. Byers and collaborators. *Transactions* of American Geophysical Union, Vol. 29–32, April 1948, pages 187–196. The paper concludes that, if properly "calibrated" against a battery of rain gages, radar can measure rainfall about as accurately as would be possible from a micronet of rain gages.

2. **The Natural and Artificial Formation of Snow in the Atmosphere.** By Vincent J. Schaefer. *Transactions* of A.G.U., Vol. 29–34, August 1948, pages 492–498. This paper describes experiments, both in the laboratory and in nature, in which small quantities of solid carbon dioxide have been used to produce enormous quantities of snow crystals from clouds of supercooled water droplets. The condition under which such action may be followed by precipitation is discussed. U. S. Weather Bureau findings differ as to the amount of precipitation that may be induced.

3. The U.S. Weather Bureau, in cooperation with other agencies, has prepared additional reports on maximum possible precipitation of the type previously published for a number of river basins in the United States. The following recent items are on this same general subject.

(*a*) **Latitudinal Variation of Maximum Observed United States Rainfall East of the Rocky Mountains.** By Robert A. McCormick. *Transactions* of A.G.U., Vol. 30–32, April 1949, pages 215–220. The paper discusses an investigation of the latitudinal variations of observed rainfall magnitudes for specific areas and durations in over 300 major storms, which reveals a remarkably consistent latitudinal location of the peak magnitudes at about 30°–31° north.

(*b*) **Maximum Recorded United States Point Rainfall, for Five Minutes to 24 Hours at 207 First Order Stations.** Prepared by A. L. Shands and D. Ammerman of the Washington Office of the U.S. Weather Bureau.

(*c*) **Generalized Estimates of Maximum Possible Precipitation Over the United States East of the 105th Meridian for Areas of 10, 200, and 500 Square Miles.** Prepared by the Hydrometeorological Section, U.S. Weather Bureau.

4. **Advances in Presentation of Climatological Data.** An important step in the processing of climatological data was made by the U.S. Weather Bureau which is now entering all its current observational data on punched cards. These cards make possible the publication on a very early schedule of rainfall and other data in the recently combined publications of Climatological Data and Hydrologic Bulletin. By means of the automatic manipulations observations can be more closely checked than was ever before possible. At the present time very little back data are being punched.

Evaporation References

1. **Forest Influences.** By Joseph Kittredge. McGraw-Hill Book Co., Inc., New York, 1948. Chapters on Evaporation and Condensation, Influences of Forest on Soil Evaporation, and Transpiration summarize the leading and most up-to-date publications on these subjects, particularly with respect to forested areas.

2. **Evaporation from Free Water Surfaces in California—Summary.** By Arthur A. Young. *Bul. No. 54*, California State Division of Water Resources, 1947. A 68-page report, prepared by the Research Division of Irrigation and Water Conservation, U.S. Soil Conservation Service, summarizes annual pan records in California from 1881 to 1946 and presents the results of research studies and development of coefficients for reducing pan records to reservoir and lake conditions.

3. **Evaporation from Free Water Surfaces in California—Basic Data.** By Arthur A. Young. *Bul. No. 54-A*, California State Division of Water Resources, 1948. This 200-page report contains some 350 tables, showing monthly evaporation, mean temperatures, and wind movement throughout the State of California. See also discussion of Mr. Young's paper "Some Recent Evaporation Investigations" (*Transactions*, A.G.U., Vol. 28, pages 279–284, 1947) by N. W. Cummings, Harry F. Blaney, and Carl Rohwer, *Transactions*, A.G.U., Vol. 29, pages 408–412, 1948.

4. **Consumptive Use of Water in the Irrigated Areas in the Upper Colorado River Basin.** By Harry F. Blaney and Wayne D. Criddle. Division of Irrigation and Water Conservation, Soil Conservation Service, U.S. Department of Agriculture, April 1949. The report consists of 50 pages, including 21 tables, and shows consumptive use of water rates at some 60 irrigated areas.

Infiltration References

1. **Infiltration, Soil Moisture, and Land-Use Relationships with Reference to Surface Runoff.** By Leonard Schiff and F. R. Dreibelbis. *Transactions*, A.G.U., Vol. 30, No. 1, pages 75–88, February 1949. This paper describes an analysis of infiltration curves derived from small natural drainage areas to reveal the physical reasons for their shapes. Transmission of infiltration water through the topsoil and subsoil, the available pore space prior to storms and its rate of depletion throughout the period of the storm and percolation rates are given to show their influence on the infiltration curves. All are interpreted in the light of soil properties and land use. Such studies reveal practical applications and bottlenecks for water-conservation programs.

2. **Elements of Applied Hydrology.** By Don Johnstone and Wm. P. Cross. The Roland Press Co., New York, 1949. A textbook prepared for use in the basic training of the civil engineer. The fundamentals of hydrology include the general concept of infiltration under the chapter head of "The Role of the Land." Explanations of how soil types and conditions, as well as soil moisture variations, affect infiltration are given. An entire chapter is devoted to "Infiltration Theory and the Analysis of the Hydrograph." Sample infiltration curves are derived from plot and natural drainage area data.

3. **Time-Condensation in Hydrograph Analysis.**

By H. N. Holtan. *Transactions*, A.G.U., Vol. 26, No. III, pages 407–413, 1945. The paper presents a graphic method for determining complete curves of infiltration capacity from intermittent natural-storm or rainfall on small drainage basins.

4. **Movement of Water Within the Soil and Surface Runoff with Reference to Land Use and Soil Properties.** By Leonard Schiff and F. R. Dreibelbis. *Transactions*, A.G.U., 1949. Infiltration rates derived from natural areas augmented by field and laboratory studies of soils and soil-moisture fluctuations were used to derive a relationship between soil moisture and infiltration capacities. These are given for rotation meadow cover on two different soil types, both topsoil and subsoil, as well as for a wooded topsoil. Values of depletion of soil moisture and the corresponding increase in the volume of empty pore space in the soil between storms, as well as the filling of pores from storm infiltration, are given for three small areas. Values of storm rainfall and runoff are also given.

Groundwater Storage References

1. **Report Upon the Reclamation of Water from Sewage and Industrial Wastes in Los Angeles County, California.** By A M Rawn, H. E. Hedger, and C. E. Arnold. (Available on application to Mr. A M Rawn, chief engineer, Los Angeles County Sanitation Districts, 1206 Maple Avenue, Los Angeles 15, Calif. Price $3.) This report deals with the reclamation of water now being discharged to the ocean through outfall sewers, principally through the medium of augmenting the groundwater supply by percolation in water-spreading grounds after adequate treatment. It emphasizes the economy of being able to select water which will be easy to treat due to the ability to discharge the balance of the flow through the existing trunk sewer system and ocean outfall. Costs of treating and spreading water are analyzed to obtain unit costs of water salvage at various locations. Results of a spreading test utilizing water from various stages of treatment at the Whittier Sewage Treatment Plant are also described. Many new data are given.

Participation in Local Section Activities Urged

EFFECTIVE PARTICIPITATION OF ASCE members in the programs of their Local Sections and development of new Section activities are objectives of a series of Local Section conferences, which have taken place all over the country in the years since the war. Recent conferences have been held in Phoenix, Duluth, Pittsburgh, Seattle, Jacksonville, and Oklahoma City.

Next in the series is the conference scheduled for October 31 and November 1 in Washington, D.C., which will coincide with the Fall Meeting of the Society. Twenty-seven Eastern Sections are expected to send delegates to these sessions, which will be held in the Statler Hotel. Subjects for discussion at the forthcoming conference include the development of Section programs, the integration of Juniors in Section activities, Section leadership in community affairs, and operation of Sub-Sections and Branches.

While Local Section conferences are primarily for delegates, any member young enough in spirit to want to lend a hand toward advancing his Section's program, will be welcome to attend and participate in the conferences.

50-Year Policy Limits Use of Society Badge

RECENT INQUIRIES RECEIVED at Society Headquarters concerning the propriety of using reproductions of the ASCE badge on personal stationery show the need for clarification of the proper use of the emblem.

Society policy, adopted by the Board of Direction in 1895, restricts reproduction of the emblem to official ASCE use—as on Society or Local Section letterheads or publications. This rules out all use of the emblem on personal, professional, or business stationery or for other display purposes. A 30-year-old ruling of the Board of Direction stipulates that certificates and badges be returned to the Executive Secretary's office by living members when connection with the Society is severed.

Ralph Budd, Hon. M. ASCE, Honored Upon Retirement

RALPH BUDD, HONORARY MEMBER OF ASCE AND FORMER DIRECTOR, is retiring at age of 70 as president of Chicago, Burlington & Quincy Railroad and its subsidiaries, which he has held since 1932. Mr. Budd has spent his entire career in railroad engineering, and during World War II served on the Advisory Commission to the Council of National Defense in Charge of Transportation, and later as colonel in the Army Transportation Corps and regional director of the Central Western Region, War Department Operations of Railroads. As guest of honor at recent party given him by presidents and chairmen of 48 railroads and large corporations at Chicago Railroad Fair, Mr. Budd was presented with an oil portrait of himself, painted by John Doctoroff (shown here). The Traffic Club of Chicago also honored Mr. Budd upon his retirement with a dinner, at which he was presented with life membership in the club. Mr. Budd has accepted the new post of chairman of the Chicago Transit Authority.

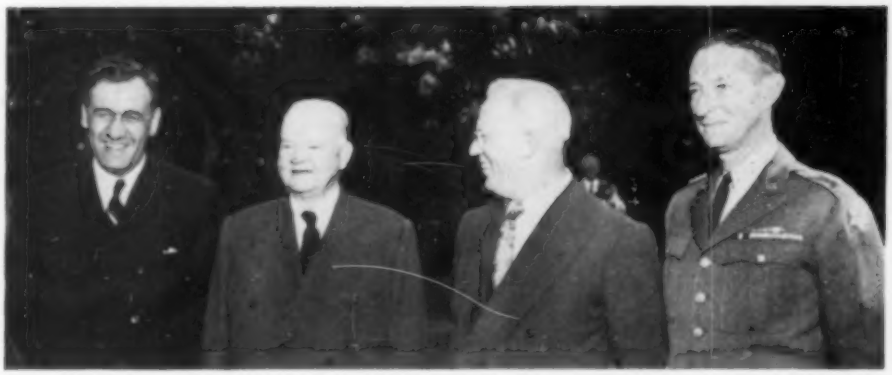
Second London Conference of Engineers Is Held

THE TREND TOWARD closer working relationships among the national engineering societies of free nations was given a strong push forward during the week of September 18–25 in London. Advancement of such relationships was the objective and accomplishment of the Second London Engineering Conference.

As was the case at the conference a year ago, the principal national engineering societies of Belgium, Denmark, France, Great Britain, Holland, Norway, Sweden, Switzerland, and the United States were represented in London by their presidents and secretaries, or by their deputies. The Engineers Council of Finland, representing some 4,000 professional engineers, was added to the Conference at this meeting and expects to have delegates present at the next meeting of the Conference which is scheduled for Amsterdam, Netherlands, in 1951. ASCE Executive Secretary Wm. N. Carey, ASME Secretary Clarence Davies, and AIEE Secretary H. H. Henline represented their respective societies and the Engineers Joint Council at the conference.

The London Conference unanimously adopted as its aims and objectives the development of direct relationships among the participating societies on a basis of mutual understanding for the purpose of aiding in the advancement of engineering science and practice. This aim is to be achieved by advancing the common aims and objectives of the participating societies; by giving all proper support to each participating society within its own country; by acting as a focus of the professional engineering opinion of the participating societies; and by cooperating with international organizations, and supporting and supplementing their work.

Thought was given at the Conference to the existing "Conference of British Commonwealth Engineering Societies," and to UPADI, the newly launched federation of the principal national engineering societies of the countries of the Western Hemisphere, mentioned elsewhere in this issue (page 48). Cooperation between these conferences of national engineering groups promises a practical method for obtaining effective international collaboration and mutual understanding among the professional engineers of the world without the cumbersome machinery of a formal constitution, permanent headquarters, secretariat, or dues. It is intended that each Society will pay its own way, and be free to withdraw any time its management feels it unprofitable to stay in the Conference. These conferences are business sessions by their management representatives, and on the business of the respective societies.



HERBERT HOOVER, HONORARY MEMBER OF ASCE AND ONLY LIVING PAST-PRESIDENT OF UNITED STATES, is photographed in Stanford University open-air amphitheater, just prior to making his famous "Think of the Next Generation" speech, which was broadcast as part of recent ceremonies honoring his 75th birthday. Shown here with Mr. Hoover are, left to right, President Wallace Sterling of Stanford, Governor Earl Warren of California, and Gen. Mark Clark, who were among many celebrities in large audience that gathered to honor him. A member of first graduating class at Stanford, Mr. Hoover has been trustee of university since 1912.

NOTES FROM THE *Capital*

Joseph H. Ehlers, M. ASCE
Field Representative, ASCE

FOR THE PAST several weeks the House has been taking a series of three-day recesses. It resumed activity again on September 21. Relatively little change has taken place in the status of legislation of interest to engineers. However, the omnibus rivers and harbors and flood control bill (H.R. 5472), last month reported as held up in the Rules Committee, passed the House immediately prior to the current recess and is now in the Senate Public Works Committee, where further hearings are being held.

Science Foundation Bill Still in Committee

The National Science Foundation bill (H.R. 5669), the latest revised version of H.R. 4846, is still in the House Rules Committee, although there seems to be some chance of action before the current session winds up. It is expected that either the Rules Committee may clear this bill or that the House will act on it under the new procedure for by-passing the Rules Committee. Chairman Crosser of the Interstate and Foreign Commerce Committee has served notice that he will move to have this bill considered by the House. This procedure requires a majority vote following the elapse of 21 days after notice is served by the committee chairman in charge of the bill.

Truman Favors Unified Transportation Agency

In connection with the transfer of the Bureau of Public Roads to the Commerce Department, the President wrote a letter to the secretaries of several departments and agencies concerned with transportation in part as follows:

"At the present time, these various federal programs are administered by a number of agencies, each concerned with a limited sector of the over-all transportation industry. A unified and coordinated federal program for transportation is clearly essential in order to assure maximum benefits from the government's activities in this field. In a broader sense, such a program is necessary to assure the public the most efficient and economical transportation service."

Public Works Advisory Committee Named

The Administrator of the General Services Administration, which has taken over several parts of the old Federal Works Agency, has established a Public Works Advisory Committee as successor to the similar committee that existed under FWA. The leading organizations in the field of public works planning and construction are represented. ASCE and ASME represent the engineering profession. The committee also has representatives from the American Institute of Architects, the Associated General Contractors, the American Public Works Association, the American Association of State Highway Officials and other groups concerned with public works.

The working of this committee is an example of the Society's efforts to cooperate more closely with the executive departments of Government.

BRAB Begins Work

The Building Research Advisory Board, which will coordinate research in the building field under the direction of the National Research Council, has commenced operations, with the selection of William H. Scheick, an architect of Urbana, Ill., as executive director.

The Society has participated in this activity through the Construction Industry Advisory Council of the Chamber of Commerce of the United States, on which Past-President J. C. Stevens represents ASCE; the Construction Department Committee of which Vice-President Carlton S. Proctor is a member; the Research Activities Committee, of which Past-President Ezra B. Whitman is the ASCE member; and the ASCE Construction Division Committee on Building Research Activity, of which Mason C. Prichard is chairman. The proposed activities of this new group will be the subject of a discussion under the auspices of the Construction Division at the approaching Fall Meeting at Washington.

The policies and program of the BRAB are determined by a board of 27, four of whom—W. E. Reynolds, E. K. Timby, C. H. Tompkins, and M. C. Voss—are members of ASCE.

Fair Labor Standards Act Revision Proposed

Proposed revisions in the Fair Labor Standards Act, which will affect the status of professional employees, were announced on September 9 by Wage and Hour Administrator William R. McComb. Labor and management are being given 30 days for comment on the proposed changes before they go into effect.

To qualify for "professional" exemption under the new regulations an employee must: (1) Receive a salary, or fees, of at least $75 a week, a rise over the present requirement of $200 a month; and (2) have as his primary duty work requiring advanced knowledge in a field of science or learning, or must perform original and creative work in an artistic field, with his non-exempt work—activities not "an essential part of and necessarily incident" to his professional duties—limited to 20 percent of *his own* weekly hours worked. Present regulations do not clearly specify a primary duty test for "professional" employees and limit their non-exempt work to 20 percent of weekly hours worked by *non-exempt employees*. Under the proposed revisions, employees receiving salaries, or fees, at the rate of $100 or more a week would be exempt on the basis of the shortened test, as specified for professional employees. Present regulations do not provide any shortened test for exemption of higher-salaried employees.

No changes are proposed in the salary regulations for employees in Puerto Rico and the Virgin Islands.

The proposed revisions are based on recommendations presented after public hearings held in January 1948. The regulations, last substantially revised in 1940, affect some 2,500,000 employees. The administrator says that the proposed revisions would not materially change the number of "white collar" workers affected, but would clarify the application of the regulations to such employees.

The regulations still attempt to define "professional" on a monetary basis, although there is a specific exemption for doctors and lawyers actually engaged in the practice of their profession. In the Society's appearance at the 1948 hearings, the following statement was made:

"We advocate the principle of licensing by the States as a measure of guarantee to the public of proper service from members of a profession which affects the every-day life of almost every citizen in a multitude of ways. We see no valid reason for setting the profession of engineering apart from the other old professions in your regulations and earnestly recommend that the salary test for engineers be eliminated in accordance with the standard established for other professions." (law and medicine)

"We protest any regulation which would deny the professional status of an employee simply because his salary was lower than an unreasonable, arbitrarily established sum when he is qualified for recognition as a professional person by reason of his education, training, and character of service rendered.

"If, in the light of existing economic conditions, it is deemed appropriate to adjust the present minimum standard of $200 per month, we consider that $300 would serve the purpose satisfactorily. It is recommended that no higher figure be adopted."

The hearing official's report finally recommended against adding engineering to the legal and medical categories which are exempt without respect to salary, although it recognized the strength of the arguments advanced, and agreed that the question might again be raised when licensing or certification of all practicing members is completed on a basis comparable to those for physicians and lawyers. The report states that the Agency in its enforcement of the regulation has always recognized engineering and architecture as professional fields of endeavor. But it adds that the salary test would be of great assistance in making a ready separation between employees carrying titles to which the term engineering is attached, who are not employed in a bona fide professional capacity, and the bona fide professional employees whose professional status is recognized by the salary paid.

In setting the new exemption level, the report adopted the $300 limit recommended in the ASCE presentation.

The minimum wage under the bill now under consideration in Congress will probably be 75 cents per hour. The new Act would broaden the coverage somewhat. In the present Act, inclusion is dependent on the activity of the particular employee. In the new Act now under consideration in Congress, all employees of any employer engaged in interstate commerce would be included.

Washington, D.C.
September 22, 1949

NEWS OF LOCAL SECTIONS

Coming Events

Akron—Meeting in the Student Union of the University of Akron, Akron, October 6, at 6 p.m.

Duluth—Luncheon meeting in the Kitchi Gammi Club, Duluth, October 17, at 12:15 p.m.

Los Angeles—Meeting at the Alexandria Hotel, Los Angeles, October 10, at 6 p.m.

Maryland—Dinner meeting in the Engineers' Club of Baltimore, October 12—dinner at 6 p.m. and meeting at 8 p.m.

Michigan—Meeting at the Engineering Society of Detroit, Detroit, October 6, at 8 p.m., preceded by dinner at 6:30 p.m.

Mid-South—Fall meeting at the Hotel Marion, Little Rock, Ark., on October 14.

Philadelphia—Meeting on October 11, beginning 2 p.m. with an inspection trip through Philadelphia public works. Trip to be followed by dinner in the Engineers' Club of Philadelphia at 6 p.m., and meeting at 7:30 p.m.

Sacramento—Regular luncheon meetings in the Elks Club, Sacramento, every Tuesday, at 12:30 p.m.

Tennessee Valley—Meeting of the Muscle Shoals Sub-Section at Sheffield, Ala., October 20, at 6:30 p.m. The fall meeting of the Oak Ridge Sub-Section at the Oak Terrace, Oak Ridge, on November 18 and 19, will feature technical sessions, inspection trips, and social events.

Texas—Fall meeting at the Plaza Hotel in San Antonio, on October 26, 27, and 28.

West Virginia—Joint meeting with the local chapter of the West Virginia Society of Professional Engineers, at the Frederick Hotel, Huntington, November 18, at 8 p.m. Meeting preceded by cocktails at 6:15 p.m. and dinner at 7 p.m.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1949

Members	7,474
Associate Members	9,675
Corporate Members	17,149
Honorary Members	40
Juniors	9,439
Affiliates	72
Fellows	1
Total	26,701
(September 9, 1948	24,107)

Recent Activities

LOS ANGELES

GOLF, SOFTBALL, AND swimming were some of the numerous sports that enlivened the Los Angeles Section's annual field day and outing. An afternoon of games and sports was followed by a dinner and program of entertainment. There was an attendance of 130.

SACRAMENTO

TECHNICAL ASPECTS OF aerial navigation were described at a recent luncheon meeting by Flight Lieutenant Leslie F. Banks, of the Royal Air Force, who traced the historical development of navigation from the primitive methods of the Phoenicians to present-day intricate techniques. At another recent meeting, Walter J. Parsons, Jr., chief of the Hydrology Section of the Sacramento District of the Corps of Engineers, explained methods used by the Corps of Engineers for establishing the magnitude of the maximum probable flood and the frequency of lesser floods as the basis for design of projects. The Section has appointed a committee to study the advisability of forming a Sub-Section for the convenience of members living in the Stockton area.

SAN FRANCISCO

NUMEROUS PHASES OF the current business situation were covered by Ira B. Cross, professor of economics at the University of California, in a talk highlighting the program at a recent meeting of the San Francisco Section. Author of books on banking, labor, and economics, Dr.

Cross discussed the Marshall Plan and its effect upon big business and the taxpayer and many other aspects of our present economy. He advocated termination of federal farm subsidies, a more rigid enforcement of anti-trust laws, and an increase in "purchasing power." The future of capitalism, he emphasized, "is in the hands of our businessmen."

SOUTH CAROLINA

ABOUT 35 MEMBERS of the Section attended the two-day annual summer meeting, held in connection with a meeting of the South Carolina Society of Engineers at Greenville. The program included an inspection trip, business session, banquet, and barbecue. The principal speaker at the banquet was Rear Admiral Carl H. Cotter, retired Naval officer and now president of the Merritt-Chapman & Scott Corp., of New York.

SPOKANE

THE NEED FOR a building code covering public assembly buildings in Spokane County was discussed by Jack Sleavin at a recent Section business meeting. The Section then voted to draft a letter to the Spokane County Commissioners recommending adoption of the structural features of a code. Other topics on the agenda included planning programs for forthcoming Section meetings and for the next annual meeting of the Pacific Northwest Conference, and the possibility of establishing a centrally located engineers' library and meeting place or club.

SYRACUSE

NEWLY ELECTED OFFICERS of the Syracuse Section are Evan W. Vaughan, president; Joseph Lamprecht and Walter G. Fielder, vice-presidents; Kenneth R. Brown, secretary-treasurer; and James E. Blowers, director. Mr. Vaughan will attend the Washington Conference of Local Sections as Section representative.

TEXAS

METHODS OF FINANCING the proposed Tarrant County road improvement program, which will cost about $3,000,000, were discussed at a recent luncheon meeting of the Fort Worth Branch by County Engineer Henry Cook. At the same meeting, Don Lee gave a report on the Society's Summer Convention in Mexico City. S. W. Freese, local consultant, spoke on a proposed water supply project for west Texas cities under the Colorado River Municipal Water District, at another recent meeting. The proposed development would involve construction of a dam and impounding reservoir on the Colorado River above Colorado City, and of a pipeline from the reservoir to Big Spring, Midland, Odessa, and possible other towns in the vicinity. Branch officers for the coming year will be John J. Burgess, president; C. Victor Thornton, vice-president; and J. K. Alewine, secretary-treasurer.

STUDENT CHAPTER *Notes*

GROUP OF SOUTHERN METHODIST STUDENT CHAPTER MEMBERS (in photo right) is pictured inspecting refrigeration equipment used in connection with proper concrete mixing. Plant manufactures ice used in batch to control temperature of concrete for Whitney Dam and Reservoir project.

IOWA STATE COLLEGE STUDENT CHAPTER MEMBERS Bill Harrington and Clarence Hughes, co-chairmen of Veishea celebration activities, and Robert Ruemping, chairman of float construction, pose (left to right) with Prof. Lowell Stewart, head of civil engineering department, who is displaying plaque received by Chapter in open-house display and trophy for best divisional float in parade.

STUDENT CHAPTER MEMBERS of University of Dayton arrange materials testing demonstration for Fifth Annual Colloquium of National Mathematics Honor Society, to which university was host this year. Shown adjusting 60,000-lb Baldwin-Southwark Universal Testing Machine in Materials Testing Laboratory are, left to right, George Vance, Nick Katsicadamus, and Gus Runkel. Colloquium is annual regional competition for member chapters of Mathematics Honor Society.

NEWS BRIEFS

Construction in August Up 3 Percent Above July Total

NEW CONSTRUCTION PUT in place during August, valued at $1.9 billion, was 3 percent above the revised July total, but 2 percent under the total for August 1948, according to recent joint estimates of the Departments of Commerce and Labor.

All types of construction advanced seasonally in August, with the exception of private non-residential building and some types of utility construction, the Construction Division of the Department of Commerce reports. Private non-farm home building, estimated at $660 million, was 2 percent above the revised estimate of $650 million for July. Private non-residential building was off 2 percent, however, as a result of continued declines in industrial and commercial building.

Though further increases in construction expenditures by privately owned gas and electric utilities were reported, new construction by railroads and telephone and telegraph companies tapered off. An advance of 4 percent in total public expenditures for new construction is attributed primarily to a seasonal increase in highway work.

Private construction for the month was 8 percent below that of August 1948, as the result of a decline of 8 percent in home building and 20 percent in non-residential building. Construction of privately owned gas and electric utilities is reported 10 percent above last year's levels for the month, while telephone and telegraph companies reduced new construction activity by 13 percent.

Public expenditures for new construction in August were 18 percent greater than in the same month last year. School and hospital building continued at high levels, as did reclamation, river, harbor, and flood control work.

A summary for the first eight months of 1949 shows that the total value of new construction put in place reached almost $12.2 billion, a rise of 2 percent over the total for the same period in 1948. This slight margin was gained during the first quarter, the Department reports. The total for the second quarter was about the same as last year, but revised estimates place the July total below the level of a year ago—a trend that was continued in August. The value of private construction put in place in the first eight months this year declined 6 percent from last year's total for the period, while public construction rose 30 percent.

Huge Volume of City Building Construction Reported for First Half of 1949

CITY BUILDING CONSTRUCTION in the first half of 1949, as measured by building permits issued and federal contracts awarded, was valued at $3.5 billion, within 3 percent of the exceptional dollar level for the same period in 1948, according to preliminary estimates of the Bureau of Labor Statistics of the Department of Labor. Urban building valuations in 1949 almost doubled between the February low point and June, when the figure stood at over $736 million, an 11 percent rise from May and nearly equal to the all-time monthly high reported in March 1946.

New home-building, valued at $1.8 billion, accounted for more than half the urban building authorized during the first six months of this year, the Bureau reports. City permits were issued for nearly 272,000 dwelling units, compared with 290,000 in the same period of 1948.

New non-residential city building for the January-to-June 1949 period, valued at $1,158 billion, was about the same as the figure for the first half of 1948. Losses in commercial and industrial building were offset by gains in other types of non-residential construction particularly community and public buildings. The increase in valuation of public buildings is attributed largely to contracts let early in 1949 for construction of the United Nations Headquarters in New York City and for a building to house the Federal General Accounting Office in Washington, D.C. The value of community building this year ($453 million) was 25 percent above the total for the first half of 1948, but industrial construction was down 29 percent to $109 million. Commercial construction in cities dropped 19 percent to $371 million, the Bureau states.

The Middle Atlantic States led all other regions in value of urban building authorized during the first six months of this year, followed by the East North Central and Pacific regions. The Pacific States retained a high position in city construction activity, despite a 21 percent drop in valuations from the first half of 1948. California, New York, and Texas were the top-ranking states this year.

New York City, with its huge apartment building program and U.N. Headquarters project, was far ahead of all other cities, with $288 million worth of building, almost double the amount recorded for the second ranking city, Los Angeles, and more than for the whole of Texas, the third ranking state.

Construction Begins on Toronto Subway Project

CONSTRUCTION OF THE Yonge Street subway in Toronto, the first to be built in Canada, was started on September 8 with ceremonies conducted by Lieutenant Governor Lawson. Cost of the project, which is being built for the Toronto Transit Commission, will be about $50,000,000.

The first two sections will be constructed by a group of American and Canadian contractors, headed by a veteran New York subway contractor, the Arthur A. Johnson Corp., of Long Island City. In association with this organization are C. A. Pitts, of Toronto; Johnson, Drake & Piper, of Minneapolis; and P. Perini & Sons, of Framingham, Mass. Design of the structure and supervision of construction are being handled by the Commission's own staff of engineers under the direction of DeLeuw, Cather & Co., of Chicago.

India Gets World Bank Loan for Railroad Reconstruction

RECONSTRUCTION AND DEVELOPMENT of the state-owned railways of India will be facilitated by a recent $34,000,000 loan from the International Bank for Reconstruction and Development. The loan will be used to replace locomotives, boilers, and spare parts, which have deteriorated considerably as a result of heavy wartime use of the railroads. Total cost of India's railway improvement program, which will involve the import of 653 locomotives with spare boilers, locomotive spare parts, and 350 tank cars, amounts to approximately $84,000,000.

The loan is made in accordance with the bank's policy of assisting the reconstruction and development of the productive facilities of member countries.

Contract Let for Buildings at Point Mugu Test Center

AWARD OF A contract for construction of technical and service buildings at the U. S. Naval Air Missile Test Center, Point Mugu, Calif., to the Alliance Construction Co., of Pasadena, has been authorized by the Chief of the Bureau of Yards and Docks, according to an announcement from Comdr. R. Lamoreaux, officer in charge of construction at the test center. The contract price for the work is $1,191,070, and the contract time for construction 240 calendar days.

The six buildings to be constructed under the contract include a test and evaluation center, a small missiles projects building, transmitting and receiving buildings, and a high-pressure air and inert gas station.

AISC Presents Awards for Esthetic Steel Bridges

AWARDS FOR THE most beautiful steel bridges opened to traffic in 1948 have been announced by the American Institute of Steel Construction. Except during the war years, the AISC has conducted an annual contest for esthetic steel structures since 1928. Entered in this year's competition were 51 bridges opened to traffic in 1948.

Two bridges received awards of stainless steel plaques. In Class I, which covers fixed bridges with spans of 400 ft or more, the plaque went to the Watauga River Bridge in Tennessee. Owned by the State of Tennessee, this structure was designed by the Tennessee Valley Authority and fabricated by the Nashville Bridge Co.

The Airport Apron Overpass, over the Van Wyck Expressway at New York International Airport, was winner in Class III, for fixed bridges with spans under 400 ft, costing less than $500,000. The owner is the City of New York, the designer was Clarke, Rapuano & Holleran, and the fabricator the American Bridge Co.

No awards of plaques were made in Class II, for fixed bridges with spans under 400 ft, costing over $500,000, or in Class IV for movable bridges.

WATAUGA RIVER BRIDGE ON STATE HIGHWAY 67, IN CARTER COUNTY, TENNESSEE (top photo), is winner of Class I award of stainless steel plaque in AISC annual competition for beautiful bridges opened to traffic in 1948. Middle view shows Airport Apron Overpass, over Van Wyck Expressway at New York International Airport, which is awarded plaque in Class III. Raymond E. Baldwin Bridge across Connecticut River, between Old Lyme and Old Saybrook (bottom photo), receives honorable mention in Class II.

In Class II, honorable mention was given the Raymond E. Baldwin Bridge between Old Lyme and Old Saybrook, Conn., which is owned by the Old Lyme-Old Saybrook Bridge Commission of the State of Connecticut. The structure was designed by the Division of Bridges and Structures of the Connecticut Highway Department. The New York and Kansas City firm of Howard, Needles, Tammen & Bergendoff acted as consulting engineers, and the fabricator was the American Bridge Co.

Honorable mention was given two bridges in Class III: The Roan Creek Bridge at Watauga Reservoir, Johnson County, Tenn., and the 159th Street Overpass over the Calumet Superhighway, Cook County, Illinois. The owner of the Roan Creek Bridge is Johnson County, Tennessee, the designer was the Tennessee Valley Authority, and the fabricator the Nashville Bridge Co. Designer of the 159th Street Overpass, which is owned by Cook County, Illinois, was the Cook County Highway Department, and the fabricator the Bethlehem Steel Co.

The jury of award included Warren Raeder, M. ASCE, head of the civil engineering department at the University of Colorado; Ralph Walker, president of the American Institute of Architects; and consultants Ernest J. Kump, Cyrus E. Silling, and Nathaniel A. Owings.

USBR Awards Contract for Wellton-Mohawk Canal

AWARD OF A Bureau of Reclamation contract for construction of 8.5 miles of main canal on the Wellton-Mohawk division of the Gila project in Arizona has been authorized by Reclamation Commissioner Michael W. Straus. Low bidder on the job, the first major construction contract on the division, was the Fisher Contracting Co., of Phoenix, with a bid of $1,335,463.70. The work is to be completed within 525 calendar days.

Construction of the Wellton-Mohawk project will be speeded to avert the present threat of salt-water intrusion on underground supplies, as well as to provide irrigated land for settlement. First irrigation on the Wellton-Mohawk division, which consists of 75,000 acres located on the Gila River east of Yuma, is planned for 1952.

Army Transfers Yuma Test Branch to Fort Belvoir

THE YUMA TEST Branch of the Army Corps of Engineers' installation for testing floating bridge design at the Bureau of Reclamation's desilting basin at Yuma, Ariz., will be closed within the next few months, according to a recent Army announcement. It is expected that transfer of the floating bridge tests to the Engineer Center at Fort Belvoir, Va., where the bridges are designed, will permit economy of operation through reduction in the number of personnel necessary to carry out tests. The Yuma Test Branch was established in January 1943.

Bids Requested by USBR on Large Western Projects

WESTERN CONSTRUCTION WORK, on which the Bureau of Reclamation will request bids by November, includes two Missouri Basin projects—Moorhead Dam and dike in Montana and Keyhole Dam in Wyoming. Moorhead Dam is to be an earthfill structure about 190 ft high and 2,660 ft long at the crest; the earthfill dike will be approximately 25 ft high and 540 ft long at the crest. Keyhole Dam, to be located on the Belle Fourche River 18 miles northeast of Moorcroft, Wyo., will be an earthfill structure 109 ft high and 3,300 ft long at the crest.

A Columbia Basin project will involve construction of earthwork, concrete lining, and structures for 19.7 miles of the West Canal near Quincy, Wash., which has a capacity of 3,100 cfs.

Detailed information concerning these projects, which are announced in the September issue of *The Reclamation Era*, may be obtained from the Denver, Colo., office of the Bureau of Reclamation.

$30,000,000 Superhighway to Be Built in Venezuela

WORK ON A $30,000,000 superhighway, linking Caracas, capital of Venezuela, with La Guaira, its seaport, will be started by the Venezuelan government this fall, according to an announcement from the Ministry of Public Works. When the project is finished, it will cut time required for the dangerous trip from La Guaira, or from the airport at Maiquetia, to the capital from an hour to 15 minutes.

The new four-lane highway will replace a present unimproved highway that follows an old Spanish trail in making the 3,000-ft ascent to the mountain capital. Construction of three steel bridges and a tunnel will help to eliminate some of the many dangerous curves on the present route. Completion of the project will require about two and a half years.

Corps of Engineers Asks Bids on Hospital Projects

BIDS ARE REQUESTED by the Corps of Engineers on several large hospitals to be constructed for the Veterans Administration. These include a 1,000-bed neuropsychiatric hospital, to be built in Pittsburgh at an estimated cost of $20,000,000. The project, one of the largest on the VA's expansion program, will be supervised by the Pittsburgh District of the Corps of Engineers. About two years will be required for completion of the job, which will include construction of 14 buildings on a 250-acre site. Bids will be opened November 15.

The New England Division of the Corps, with headquarters in Boston, will supervise construction of two VA hospitals in the New England area. Bids will be opened November 29 on a 900-bed hospital, to be built at West Haven, Conn. Opening of bids on a 1,000-bed hospital in Boston is scheduled for January 10. The cost of both projects is estimated at from $14,000,000 to $16,000,000.

Representatives Appointed to GSA Public Works Group

REPRESENTATIVES OF twelve national organizations have been appointed to serve on the Public Works Construction Advisory Committee of the General Services Administration, according to a recent announcement from Jess Larson, GSA administrator. Mr. Larson stated that, "In carrying out the public works functions transferred to the General Services Administration from the former Federal Works Agency, GSA wants to have the benefit of consultation with representatives of the leading organizations in the field of public works planning, construction, and operation."

Chairman of the new committee is Edmund R. Purves, executive director of the American Institute of Architects, and F. Stuart Fitzpatrick, manager of the Construction and Civic Development Department of the Chamber of Commerce, is secretary.

Other members are Frank Bane, executive director of the Council of State Governments, Chicago; Col. Paul Betters, executive director, United States Conference of Mayors, Washington, D.C.; Joseph H. Ehlers, M. ASCE, Field Representative, ASCE, Washington, D.C.; Carl H. Chatters, executive director, American Municipal Association, Chicago; Herman E. Foreman, managing director, Associated General Contractors of America, Inc., Washington, D.C.; Richard J. Gray, president, Building and Construction Trades Department, American Federation of Labor, Washington, D.C.; Hal H. Hale, M. ASCE, executive secretary, American Association of State Highway Officials, Washington, D.C.; S. Logan Kerr, M. ASCE, American Society of Mechanical Engineers, Philadelphia; Charles M. Mortensen, executive secretary, the Producers' Council, Washington, D.C.; and William A. Xanten, president, American Public Works Association, Washington, D.C.

Hydraulic Experts Meet at Rocky Mountain Laboratory

THE FLOW OF WATER and allied subjects were discussed by hydraulic experts at the third annual meeting of the Rocky Mountain Hydraulic Laboratory, held recently at Allenspark, Colo. Speakers included J. N. Bradley, hydraulic engineer for the U.S. Bureau of Reclamation at Denver, whose subject was the use of gates for measuring irrigation water; D. M. Lancaster, U.S.B.R. engineer at Denver, who described flow-measuring devices as observed in the field; and Prof. Ralph W. Powell, of Ohio State University, who discussed flow in rough channels. All are ASCE members. Gerard H. Matthes, Hon. M. ASCE, president of the Rocky Mountain Laboratory, presided at the all-day meeting.

The following trustees of the laboratory were reelected: ASCE Honorary Members Hardy Cross and J. L. Savage, ASCE Past-President J. C. Stevens, and Royce J. Tipton, M. ASCE.

New York City Lays Test Sections of Rubber Streets

RUBBERIZED PAVEMENT IS LAID BY NEW YORK CITY on section of lower West Side Highway, as part of experiment in use of rubber to provide safer and more durable streets and cut maintenance costs. Pavement, which is laid over existing concrete surface, consists of 1½-in. layer of asphalt mixed with United States Rubber Co. compound known as Surfa-Seals. The compound, which will undergo two-year tests on several busy city streets, is expected to prolong pavement life by preventing cracking in winter and softening in summer.

General Motors to Have Huge Technical Center

PRELIMINARY GROUNDWORK FOR a huge new General Motors Technical Center is now under way on a 320-acre site just north of Detroit and first buildings will be ready for occupancy by the late summer of 1950. With the aim of developing closer liaison between General Motors research and experimental facilities and the production units of the organization, the new center will house its vast research, engineering staff, processing, and styling operations.

According to William J. Davidson, administrative engineer of the Technical Center, the construction timetable will extend over the next three years. Construction of the Engineering Group, consisting of administration and drafting, shop, and dynamometer buildings and involving a total of 235,000 sq ft of office and shop space, will get under way first. Work on the Research Laboratories Division Group, covering 427,000 sq ft of office, laboratory, and shop space, will start later this year. Buildings will be grouped around a 22-acre lake that will have a utility value in connection with the operation of the center.

The Bryant & Detwiler Co., of Detroit, has been awarded the construction contract. Project architects are Saarinen Saarinen & Associates, Bloomfield Hills, Mich., and the architect-engineers are Smith, Hinchman & Grylls, Inc., of Detroit.

TYPICAL OF OFFICE BUILDINGS PLANNED for new General Motors Technical Center, north of Detroit, is architect's drawing of the Engineering Group Administration Building. This particular structure, 350 ft long and 50 ft wide, will have clear-span construction, with no interior posts or columns. Exterior walls, in general, will consist of thermopane or transparent glass units separated by dehydrated, captive air and sealed around the edges with a metal-to-glass bond, providing office workers ample natural light with absence of drafts. Both modern and functional in concept, buildings are planned for maximum flexibility of space requirements.

Improved Federal Building Practice Lowers Construction and Upkeep Costs

FEDERAL BUILDINGS OF the future will be greatly simplified in design to achieve economy in construction and maintenance costs, W. E. Reynolds, M. ASCE, commissioner of public buildings, states in a current issue of *Public Construction*, publication of the General Services Administration. New materials and techniques developed during the war and new uses for more conventional types of building construction will be incorporated in government buildings.

Innovations in building design listed by Mr. Reynolds include the installation of radiant heating pipes to speed the removal of snow and ice from exterior ramps; thermally insulated roofs to keep indoor temperatures even; elimination of unnecessary ornamentation; and use of nonferrous metals for doors and windows to eliminate painting and reduce maintenance costs, glass block in certain functional locations, and resilient floor materials devised or improved during the war. Special floors needed in federal buildings include "certain kinds of stone in melting rooms in mints, steel in foundry rooms, asphaltic floors where moisture is constantly present, and wood blocks in heavy trucking areas."

Roof parapets, which are a source of leaks involving costly repairs because of the variety of flashings required, will be eliminated. Instead of parapets, the tops of projecting cornices or copings will be placed slightly above the roof level, with an inconspicuous gravel stop at the outer edge of the cornice. The roof is then pitched back to turn the drainage away from the outside faces of the walls.

Economy in construction and repair requires that mechanical facilities, such as pipes, air-conditioning ducts, and wire shafts be planned in vertical tiers, according to Mr. Reynolds. He states that a system of grid construction is in a preliminary stage of investigation, and that modular structural units, which will reduce construction costs, are also being studied.

Precautions against accident will also be embodied in the plans. These include elimination of exterior steps, whenever possible "A type of window that can be cleaned from the inside is under experiment," Mr. Reynolds reports. "Colors will be used to identify safe or hazardous conditions. Pipes buried in wall chases and electric conduits, telephone wiring, and ducts, concealed in walls and floors, will be identified by various colors so that repair or extension of these facilities can be completed easily and safely."

Before construction starts, according to the writer, application of the science of soil mechanics in the design of foundations will result in a saving in initial cost of foundation construction, and reduction in, or elimination of, unequal settlement after the structure is built. Other construction preliminaries include analysis of the activities of the agency that will occupy the building in order to arrange for their efficient and economical operation.

VMI to Be Host to Third Annual Highway Conference

THE THIRD ANNUAL Virginia Highway Conference will be held at Virginia Military Institute in Lexington, Va., on October 20 and 21, under joint sponsorship of the Institute and the State Highway Department.

To broaden the scope of the conference, armed service transportation officers and representatives of Virginia railroads have been invited to appear on the program. New emphasis will also be placed at this year's conference on giving county, city, and town authorities an opportunity to air their local road and street problems. A special panel discussion will be devoted to the highway problems of political subdivisions of the state.

Undergraduate Award and Scholarship Program Open

AWARDS AND SCHOLARSHIPS totaling $6,750 will be open to undergraduate engineering students and schools in the 1949-1950 competition of the James F. Lincoln Arc Welding Foundation. The current competition, third in a ten-year series, will make available a total of 77 awards, ranging from $25 to $1,000, to students and $1,750 to schools for seven scholarships. These awards will be given for the best papers on arc-welded design, research, fabrication, or maintenance.

Details of the contest may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

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Bergen County, New Jersey, Starts Large Sewer Project

A 20-MILE AREA in the Tenafly-Little Ferry region of northern New Jersey will be served by the new Overpeck Valley Project of the Bergen County Sewer Authority, initiated at ground-breaking ceremonies in Ridgefield Park, N.J., on September 10. About two years will be required for completion of the project, which will include construction of a 20-mgd treatment plant at Little Ferry. Treatment will be of the activated sludge type, with the effluent discharging into the Hackensack River. The project will serve a population of 180,000, and treat 2 mgd of industrial wastes.

Contracts totaling $9,300,000 have been let to a number of organizations, with the contract for the treatment plant going to the Terminal Construction Co., of Woodridge, N.J. Engineers on the project will be the New York City firm of Bogert-Childs Engineering Associates.

PROPOSED PUMP and blower house for Overpeck Valley Sewage Treatment at Plant Little Ferry, N.J., is shown here in photograph of architect's rendering.

USBR to Make Two-Way Use of Alva B. Adams Tunnel

THE DECISION OF the Bureau of Reclamation to make two-way use of its 13-mile Alva B. Adams irrigation tunnel under the Continental Divide in Colorado will result in a saving of almost $500,000, according to Michael W. Straus, Commissioner of Reclamation. When completed the 9-ft, 9-in. tunnel, which is part of the Colorado-Big Thompson Project, will carry water from the west slope of the Rockies to hydroelectric plants on the east slope. Part of the power generated in these plants will then be returned through the tunnel, via a transmission line, to pump more water eastward through the tunnel. The transmission line will be contained in a gas-filled pipe to keep out moisture, and will be strung along the ceiling of the tunnel.

Benefits of the dual use of the tunnel, in addition to the saving in construction costs, include eliminating "the necessity of erecting and maintaining a tower transmission line across one of the highest and most rugged sections of the Rocky Mountains," according to Commissioner Straus. "There is a calculated risk involved in that any emergency maintenance of the cable might require stopping the flow of water through the tunnel, but technicians report that this risk is no greater than that in maintaining a tower transmission line through an almost inaccessible area, which is swept by bitter cold storms every winter with severe icing conditions," he said.

Unification of Screw Threads Sought at Paris Conference

STEPS TOWARD INTERNATIONAL unification of the various national screw-thread standards were taken by the International Standardization Organization at a recent three-day meeting in Paris, according to a report from the American Society of Mechanical Engineers. Delegates from 15 of the 18 countries represented voted to recommend the recently established Unified Anglo-American Screw Thread to their national standardizing bodies "as the common profile for the metric and inch systems of screw threads."

Other resolutions established a subcommittee to define the scope of the Technical Committee, known as ISO-T1; a decision to refer to the Unified Anglo-American Screw Thread as the "ISO Basic Profile"; a program of work for the Technical Committee; and a working commission to aid in the preparation of documents and the presentation of data for the Technical Committee.

Corps of Engineers Holds Large Safety Conference

BUILDING SAFETY INTO the job was the theme of a recent six-day conference of army officers in Omaha, Nebr., sponsored by the Corps of Engineers. Engineer officers from all over the country took part in the program, which was "designed to emphasize and intensify the planning and inauguration of safety measures from the time a construction job starts until it is completed." ASCE members represented included Sidney Price, chief of the Omaha District Estimates and Specifications Sub-branch, and G. S. Cairns, of the Great Lakes Division of the Corps. The conference included an on-the-job study of safety measures required on construction of Fort Randall Dam.

In his address of welcome, Brig. Gen. Samuel D. Sturgis, Jr., Missouri River division engineer, pointed out that "Safety planning and engineering is a definite part of the year-round construction program of the Corps of Engineers. It pays dividends in lives saved and in prevention of destruction of equipment and property."

Refresher Courses Given for New York State Examinations

EVENING "BRUSH-UP" COURSES for engineers planning to take the New York State professional examinations are being held in the Engineering Societies Building in New York City, under the joint auspices of metropolitan sections of the ASME and AIEE. Of special interest to civil engineers are the courses in structural planning and design and the basic engineering sciences. Elementary and advanced courses in public speaking are popular with all groups.

Inquiries concerning the courses should be addressed to either J. C. Hoyt, of the Kellex Corp., 233 Broadway, or A. T. Kniffen, of the Air Reduction Sales Corp., 295 Madison Avenue, or to the headquarters of the ASCE, ASME, or AIEE, 29–33 West 39th Street, New York 18.

Another refresher course with an established reputation is given under the auspices of the Cooper Union Alumni Association, 313 West 53rd Street, New York 19.

Waterways Experiment Station Jurisdiction Is Transferred

ANNOUNCEMENT OF the recent transfer of the Waterways Experiment Station to the direct jurisdiction of the Chief of Engineers has been made by Lt. Col. Ralph D. King, Assoc. M. ASCE, director. The Experiment Station was previously under the jurisdiction of the President of the Mississippi River Commission. The transfer will cause some changes in administrative procedure but will not affect the organization or location of the Station. Under the new program, the director has been delegated authority equivalent to that of a division engineer.

The Waterways Experiment Station will now exercise technical supervision over all hydraulic model tests, whether performed at the Station, other Corps of Engineers laboratories, or at universities, and over concrete and soils investigations directed by the Chief of Engineers. Under the present program, the director will coordinate all testing programs, except those of a routine nature normally performed in Division Laboratories, to insure the effective utilization of all Corps of Engineers civil works experimental facilities.

Established at Vicksburg, Miss., as a hydraulic laboratory in 1929, the Waterways Experiment Station has expanded its facilities to include the study of soil mechanics, flexible pavement (asphalt), research in concrete, and operation of the Corps of Engineers research center.

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Weather Data Studied as Guide to Builders

THE RESULTS of 27 months of study of the effect of weather on various urban centers of the country were reported by Dr. Paul Siple, chief of a "climate control project" being conducted by *House Beautiful*, at a recent forum sponsored by the magazine in New York. The research project is designed to correlate known meteorological data, so that the builders and designers of communities and individual homes may use favorable climatic conditions to advantage and overcome adverse conditions. Over a period of time the project will make available to the public charts and graphs of temperature, humidity, prevailing winds, rainfall, snowfall, and the percentage occurrence of these various phenomena for all the differing regions of the country.

Film Showing Making of Portland Cement Available

EACH STEP IN the making of portland cement, from quarrying or dredging raw material to the packing operation, is shown in a 30-minute sound and color film recently released by the Portland Cement Association. Entitled "The Drama of Portland Cement," the film covers research activities in laboratory and field devoted to improving the product and the application of portland cement in concrete structures as well as cement-making processes.

The 16-mm film will be loaned without charge to engineering and architectural colleges and societies, civic and business clubs, and builders associations. Inquiries should be addressed to the Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.

Construction Employment Reported Up in August

EMPLOYMENT BY CONSTRUCTION CONTRACTORS rose by 54,000 between mid-July and mid-August to a total of 2,333,000, as a result of more construction jobs in almost every section of the country, the Labor Department's Bureau of Labor Statistics reports on the basis of preliminary estimates. Though the August employment level was the highest reached thus far in 1949, it fell about 50,000 short of the postwar peak set in August 1948. Most of the rise from July to August occurred in the East North Central and West South Central regions, where substantial employment gains have taken place.

The heaviest concentration of contract construction employment is in the Middle Atlantic Region where more than one-fifth of the total number of workers is employed, with New York State leading the country. The next ranking states in contract construction employment are California and Texas.

Creosoted Timber Bridge Speeds Logging Operations

TIMBER AT HAND PROVIDES ECONOMICAL AND EFFECTIVE TRESTLE for transportation of logs on St. Helens Tree Farm of Weyerhaeuser Timber Co., east of Castle Rock, Wash. Maximum height is 235 ft. Total over-all length of 1,126 ft consists of pile-trestle approaches of conventional design, and 476-ft all-creosoted timber-framed trestle center section, center 120 ft of which is superimposed on arch span. Timber in approaches is untreated, except for creosoted caps. Center section required 2,000 lin ft of piles and 57,600 fbm of timber in arch, and 350,160 ft of timber in the framed bents. Also required were 4,400 Teco connectors, including split rings, shear plates, and spike grids. Photo through courtesy of "Weyerhaeuser Magazine."

NEW IN Education

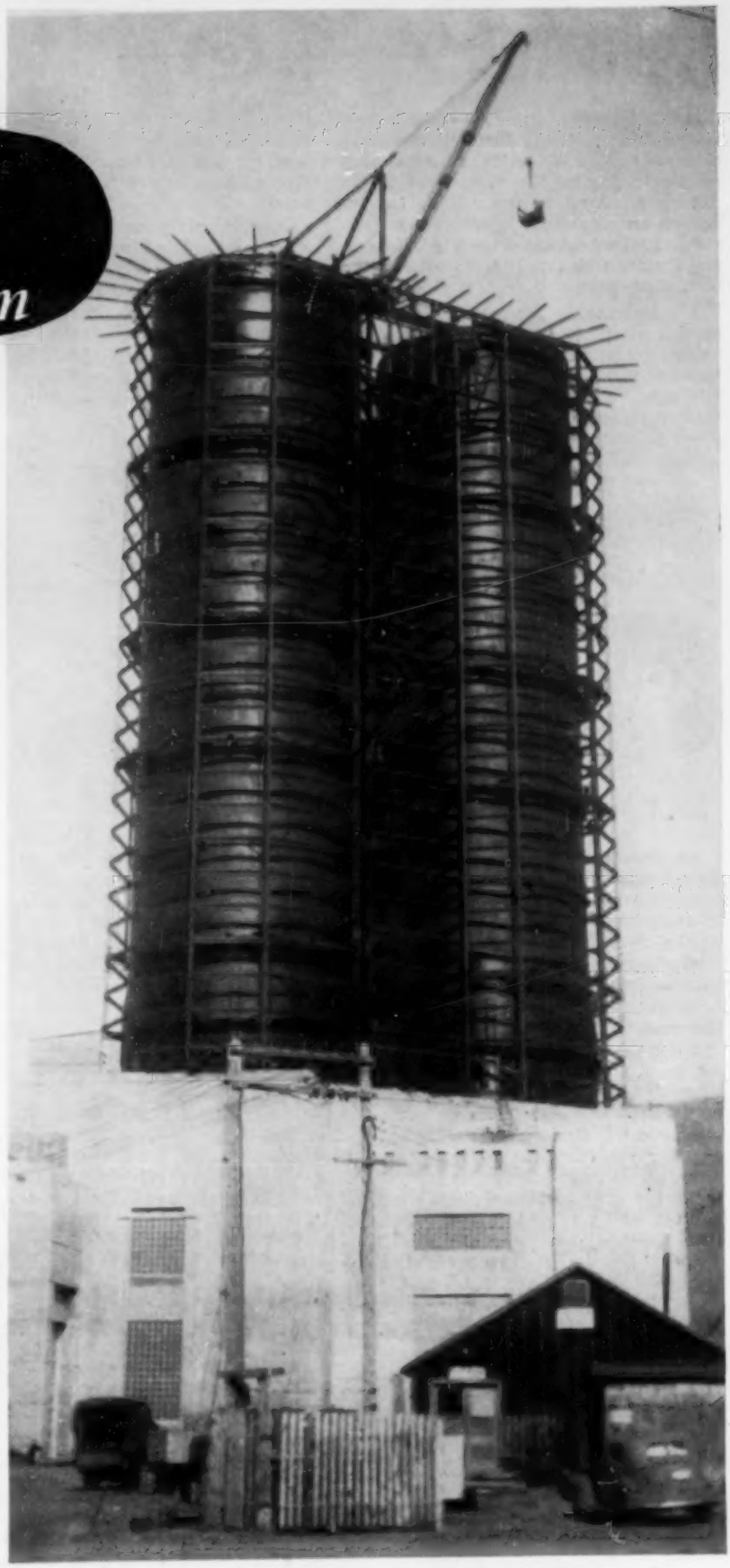
INTEREST AND ACTIVITY in the field of air pollution have reached such proportions that the Stanford Research Institute is sponsoring a National Symposium on Air Pollution, to be held at the Huntington Hotel in Pasadena on November 10 and 11. Cooperating colleges are the California Institute of Technology, the University of California, and the University of Southern California. Subjects slated for discussion on the two-day program include the biological and medical effects of pollution on plants and animals; the effect on visibility; meteorological aspects; methods of sampling and analysis; reduction or elimination of air pollution at its source; and influence on industrial planning and plant location.

THE ROLE OF UNIVERSITY RESEARCH in its relationship to industrial development will be explored by a panel of speakers from notable engineering laboratories in the West at a two-day Conference on Industrial Research, to be sponsored by the South Dakota School of Mines and Technology on October 20 and 21. These include Dr. Harold V. Gaskill, dean of the Division of Science, Iowa State College; Dr. Carl J. Christensen, dean of the College of Mines and Mineral Industries of the University of Utah; and Dr. Jesse R. Hobson, director of the Stanford Research Institute. Among other speakers are Rear Admiral F. E. Beatty, of the Naval Ordnance Laboratory, Silver Springs, Md., who will describe the necessity for and magnitude of the Navy's research program, and Dr. Archie M. Palmer, director of the Patent Policy Survey of the National Research Council, who will discuss the relation of research to industrial and economic development.

THE FIFTH ANNUAL National Conference on Industrial Hydraulics, to be held at the Sheraton Hotel in Chicago on October 26 and 27, will serve as a clearing house where those working in industrial hydraulics can discuss their mutual problems. The mechanics department of the Armour Research Foundation of Illinois Institute of Technology, together with the Illinois Tech graduate school, is sponsoring the two-day symposium, in cooperation with local groups of the ASCE, ASME, the AIChE, SAE, the American Society of Lubricating Engineers, and the Institute of Aeronautical Sciences, and the Western Society of Engineers.

IRRIGATION ENGINEERING ACTIVITIES at the Colorado Agricultural and Mechanical College, Fort Collins, are being expanded to keep pace with the "vastly expanding national program of irrigation and reclamation," according to a recent announcement from T. H. Evans, M. ASCE, newly appointed dean of the division of engineering there. On the campus there is a large hy-

Surge Tanks at Fort Peck Dam



absorb momentum equal to a 45,000-ton Battleship under way!

Yes, that's right. These surge tanks at the world's largest earthfill dam at Fort Peck, Montana, will absorb a momentum approximately equal to that attained by a 45,000-ton battleship traveling 20 m.p.h.! This terrific momentum is created by water which flows to the Fort Peck power house through a tunnel 5,667 ft. long. The use of surge tanks to absorb this force avoids excessive penstock pressures or any hydraulic instability resulting from a sudden change in the load on the turbines.

But strenuous service is only part of this surge tank story. The building skill that made this performance possible was based on three factors—coordinated effort, ingenuity, and just plain experience. U.S. Engineers—working closely with CB&I personnel—prepared the basic design and supervised the shop work. Fabrication of these three 40-ft. diam. by 160-ft. high "giants" required ingenious methods of assembly and machinery especially designed and built by CB&I for this particular project. Finally CB&I's long experience in furnishing surge tanks and similar equipment helped at every step from starting design to final erection.

The Fort Peck project dramatically illustrates how well CB&I is equipped to handle steel plate work for civil engineering projects. We also furnished a steel tunnel liner, three penstocks (two are being used, one is bulkheaded and stub-ended for the present), a wye-branch, and three large diameter riser pipes connecting the penstocks to the surge tanks. On your next job, write to our nearest office for quotations on steel plate structures.

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Houston 2...2128 National Standard Bldg.
Los Angeles 14..1556 General Petroleum Bldg.
New York 6..3395—165 Broadway Bldg.
Philadelphia 3.....1652—1700 Walnut St.
Salt Lake City 1..1509 1st Security Bank Bldg.
San Francisco 11..1284—22 Battery St. Bldg.
Seattle.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNA.

draulic laboratory, where research is conducted for the Office of Naval Research, the Government of India, and the U.S. Geological Survey, under the supervision of Dr. Maurice L. Albertson, Jun. ASCE. Investigations are also made in cooperation with the Irrigation Division of the Soil Conservation Service, which maintains a notable staff on the campus.

A LONG-RANGE PROGRAM of practical application in the teaching of technical writing got under way at Rensselaer Polytechnic Institute with the opening of the fall term. Under this program, which is being supervised by Dr. C. H. Gray, head of the English department, English teachers will be assigned to each engineering department for work with students in planning and revising term papers, theses, and technical reports. Stating that "A prime necessity in engineering education is to train students in good technical writing," Dr. Gray points out that, "If the engineer is to see his work projects translated into reality, he must be able to describe them clearly and exactly. He can't tell the whole story with a blueprint and a sliderule. If he is to receive credit for a job well done, he must be able to make an intelligent report to his employer."

R. Robinson Rowe, M. ASCE

"A PRACTICAL ENGINEER has been defined," said Professor Neare, "as an ordinary chap who can build anything with horse sense and a handbook, in contradistinction to the academic engineer who utilizes intricate formulations and elaborate analyses to accomplish an identical objective. In twice as much time, that is. So heed well the words of Guest Professor Jenney as he unravels the problem of the loose-leaf notes, for he has a few cute formulas up his sleeve."

"I resent that, Noah, if you mean I'm impractical, but I'll admit that the problem won't appeal to practical men like Joe Kerr."

"But it did," exclaimed Joe Kerr, "and I did it, tho' not too precisely. Obviously Al E Dayde's lot was a quadrilateral interscript between circles of 70- and 120-ft radii. Now the largest that could be inscribed in the 120-ft circle is a square with an area of 28,800 sq ft and the smallest that could be circumscribed about the 70-ft circle is a square of 19,600 sq ft, so the lot area can be expressed as 24,200 ± 4,600. Also, the diagonal of the square house is the eccentricity of the two circles, which cannot exceed 50 ft, so its area can be expressed as 625 ± 625. Subtracting, the net area of the yard was 23,575 ± 5,225, which is the answer to a precision of 0.22."

"Joe's smart, but lazy," scoffed Cal Klater. "It's just trigonometry. The relation between opposite sides and angles is easily found to be:

$$a + c = b + d = s \quad \ldots\ldots (1)$$

$$A + C = B + D = \pi \quad \ldots\ldots (2)$$

It was given that $a = 2.5c$ and there are plenty of right triangles to set up enuf equations for a unique solution. I found $A_y = 22{,}342 - 900 = 21{,}442$ sq ft."

"Which is easily within Joe's limits and much much closer, said Professor Jenney. "However, it would be easier to add the following general relations to your Eq. 1:

$$A_l = rs = \sqrt{abcd} \quad \ldots\ldots (3)$$

$$R = r\sqrt{k(k+1)} \quad \ldots\ldots (4)$$

$$e = r\sqrt{k(k-1)} \quad \ldots\ldots (5)$$

in which r and R are the inner and outer radii, e is the eccentricity and k is the quadrilateral shape factor

$$k = \frac{1}{4}\left(\frac{a}{c} + \frac{b}{d} + \frac{c}{a} + \frac{d}{b}\right) \quad \ldots\ldots (6)$$

From (4), $k = \frac{9}{7}$; from (5), $e = 30\sqrt{2}$; from the others, $ac = 20{,}790$, $bd = 24{,}010$ and $A_l = 1{,}470\sqrt{231} = 22{,}342.0657$."

"That's surely the easiest way to do it, Dick," admitted the Professor, "and the problem is so interesting that it deserves a sequel. Suppose the 4 straight streets, Arab, Bloc, Cord and Dana, had center lines intersecting at points A, B, C and D, corresponding to terminal letters of the street names. Then suppose Al referenced the network by setting a monument at P 250 ft from each of the center lines and another at Q 250 ft from each of the 4 intersections. How far do you suppose P would be from Q?"

[Cal Klaters were Stoop (John L.) Nagle, Ephraim C. Centric V (Howard Blodgett), J. L. Frack, and Anne Othernut (J. Charles Rathbun). Guest Professor Dick Jenney is really Richard Jenney.]

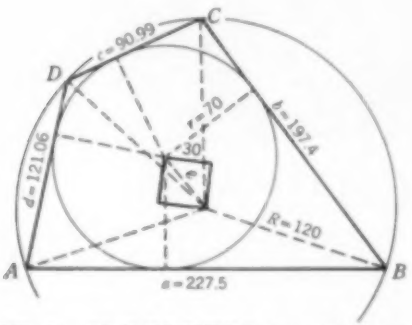

FIG. 1. AL E DAYDE'S Interscript Trapezium

NEWS OF Engineers

Ray Goodson is now an assistant professor of civil engineering at Southern Methodist University. He recently returned to Dallas after a year in New York, where he studied for his master's degree.

Pedro Albin, Jr., has become affiliated with the Western Foundation of Mexico S.A. in the capacity of chief engineer.

Conrad Blucher and **James Naismith** have formed a partnership under the firm name of Blucher & Naismith, with offices in Corpus Christi, Tex. Mr. Blucher has served as Nueces County surveyor for many years, and Mr. Naismith was until recently associated with the contracting concern of Lee Atkin.

H. H. Allen, formerly city manager of Corpus Christi, Tex., has taken a position with the Tennessee Coal, Iron and Railroad Co., at Houston.

Maurice Barron and **Nicholas Farkas** have formed a consulting partnership under the name of Farkas & Barron, and will be located in New York City. The firm succeeds that of Sigman & Farkas. Previously Mr. Barron was chief engineer in the structural division for Clarke, Rapuano & Holleran.

Eugene A. Dubin announces the opening of an office for the general practice of structural engineering in Chicago.

Vernon H. Rosebraugh has accepted the position of instructor in engineering at the University of Oregon. A graduate of Oregon State College, Mr. Rosebraugh has been engaged by the Corps of Engineers in the hydraulic laboratory at Bonneville.

Richard M. Starns, Jr., consulting engineer, announces that his office is now established at 2054 University Avenue, Berkeley, Calif.

Conrad P. Hardy, former European Command deputy chief engineer, has been assigned to the post of district engineer in the Pittsburgh, Pa., office of the Corps of Engineers. Colonel Hardy will be responsible for the Army's work in river, harbor, and flood control work there, as well as the construction of veterans' hospitals. Starting his military career in 1917, Colonel Hardy was awarded the Legion of Merit for outstanding work as district engineer in the Seattle, Wash., area.

Gustav Magnel, director of the Reinforced Concrete Laboratory at the University of Ghent, Belgium, is to be in Philadelphia in connection with the tests of the Walnut Lane Bridge.

(Continued on page 66)

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720 Ditcher

For digging trenches 8" to 11" wide—up to 4 feet in depth. Digging speeds up to 32 F.P.M.; traveling speeds as high as 234 F.P.M. adjustable spoils conveyor discharges on either side. Three-position boom adjustable to dig close to obstructions. Simple B-G controls, easy-steering.

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(*Continued from page 64*)

D. J. Belcher, who has been professor of civil engineering at Cornell University, announces the formation of the firm of D. J. Belcher & Associates, of Ithaca, N.Y. Aerial photography analyses will be the organization's specialty.

Walter J. Ryan, Tacoma, Wash., consultant, has accepted an assignment with the Division of Forestry of the New Zealand government, where he will make a report on forestry methods and equipment on a large tract of forest that New Zealand is opening up for logging. Mr. Ryan expects to complete his investigation and report and return to Tacoma before December 21. He recently retired from the Weyerhaeuser Timber Co. after 33 years of service.

W. P. Jones, Jr., has assumed new duties as officer-in-charge of the San Antonio suboffice of the Corps of Engineers. Prior to this assignment, Colonel Jones served as executive officer of the Personnel Division in the Office of the Chief of Engineers, Washington, D.C.

Melvin Jackson, formerly structural design engineer for J. B. Dennenbaum & Co., of Houston, Tex., has been named assistant professor of civil engineering at the Georgia Institute of Technology.

Henry O. Pond, district purchasing manager for the H. K. Ferguson Co., engineers and builders of New York, is reentering private consulting practice. He will be retained by the H. K. Ferguson Co., as a consultant.

E. T. Roetman, who is chairman of the research committee of the Interstate Commission on the Potomac River Basin, is now engineer for the Federal Security Agency at Dallas, Tex. Mr. Roetman was previously in the employ of the American Viscose Co.

William L. Voorduin has been appointed engineering consultant to the United Nations Economic Survey Mission to the Middle East. On leave of absence from Gibbs & Hill, Inc., Mr. Voorduin expects to return around November.

William A. Stancer succeeds **Finch Van Slyke** as Pierce County engineer at Tacoma, Wash. During the recent war Mr. Stancer served five years in both the European and Pacific theaters of war.

Howard P. Gerlach was recently appointed vice-president of John W. Harris, Associates, Inc., builders, with offices in New York and Chicago. Mr. Gerlach will be in charge of the Chicago branch of the organization. While affiliated with the Hotel Statler chain, Mr. Gerlach served as owner's representative on the construction of the Washington Hotel Statler.

A. E. Rush, who has been serving the Tennessee Valley Authority as senior civil engineer at Knoxville, has been transferred to Chattanooga where he is engaged in a similar capacity on backwater adjustments.

Norman H. Collisson has returned to Germany, where he will be chief of the Economic Cooperation Administration Special Mission to Western Germany, with the rank of minister. Mr. Collisson served as Coal Mines Administrator during the federal operation of the bituminous mines. As special assistant to the Secretary of the Interior J. A Krug, he helped to coordinate and direct the various activities of the departmental agencies engaged in work on the Marshall Plan.

Norman H. Collisson

G. H. Hickox, until recently with the hydraulic laboratory of the Tennessee Valley Authority, has accepted a position as director of the Engineering Experiment Station at the University of Tennessee.

Reading Wilkinson, retired army officer and former Charleston, S.C., district engineer, has become connected with the John McCrady Co. Since his retirement from the army after 30 years of service, Mr. Wilkinson has been a consulting engineer.

Emil H. Praeger, consultant to the United Nations on its headquarters under construction in New York City, has been named consulting engineer of the Ibec Corp., which is working on a low-rent housing project in Norfolk, Va. Mr. Praeger is a partner in the firm of Madigan & Hyland.

T. H. Campbell and **H. M. Chittenden,** on the faculty of the University of Washington, have been elevated from the rank of assistant professor to that of associate professor.

Robert W. Skidmore, until recently engaged in private practice in Birmingham, Ala., is now Morgan County engineer. Mr. Skidmore has served as state airport engineer, field engineer with the Tennessee Coal and Iron Co., and chief engineering inspector at the Courtland Air Base.

Edmond H. Leavey, major general, after 32 years of active commissioned service with the Army, has retired. General Leavey's last assignment was that of Army Comptroller.

Harold Flinsch has been named dean of the school of engineering at Mississippi State College. He was previously associate dean.

Two ASCE members—**Maj. Gen. Philip B. Fleming** and **Maj. Gen. U. S. Grant III**—were recently cited by the American Institute of Architects for their "public service records." General Fleming, now chairman of the United States Maritime Commission, was cited for his "able work and brilliant administration of the Federal Works Agency" from 1941 to 1949. General Grant was commended for his "many years of devoted service to the development of the city of Washington and for his major contributions to the art of planning."

Francis S. Friel, member of the Philadelphia consulting firm of Albright & Friel, Inc., has been elected to the Board of Trustees of Drexel Institute, his alma mater.

Walter N. Frickstad, who has retired as city engineer of Oakland, Calif., was honored at a recent testimonial dinner sponsored by the Chamber of Commerce.

Carl M. Berry recently terminated his work as location engineer with the Bonneville Power Administration, at Portland, Ore., to open offices in Tacoma and Seattle, Wash., where he will practice engineering.

Clarence R. Andrew has retired as civilian engineering consultant of the Chicago District of the Corps of Engineers. Mr. Andrew served the Engineer Corps for [illegible] years.

Thomas S. Burns, former Boston, Mass., consultant, is now engaged by Daniel Dinerman, of Buenos Aires, on the design of hydroelectric and irrigation developments for the Republic of Argentina.

Robert C. Sheldon, since 1942 a commander in the Navy Civil Engineer Corps, has been named assistant to Dean A. [illegible] Webb, of the engineering department at Ohio Northern University. From 1928 to 1942 Mr. Sheldon worked as an assistant engineer at the Panama Canal.

T. C. Forrest and **James A. Cotton** have formed the consulting partnership of Forrest & Cotton, with offices in Dallas, Tex. Mr. Forrest is a pioneer in the field of flood control in Texas, and Mr. Cotton has been engineer-in-charge of the Fort Worth suboffice of the Galveston District of the Corps of Engineers.

George A. Nelson has been appointed city engineer of Boone, Iowa.

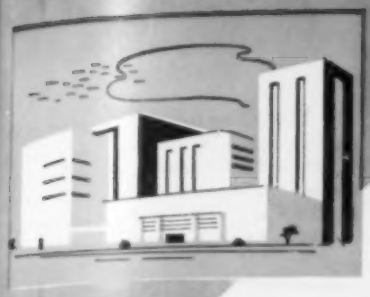
James H. Carnine, president of Engineering Metals Products Corp., of Indianapolis, Ind., has accepted the appointment to the Board of Sanitary Commissioners of the city, succeeding the late **Warren Bevington.**

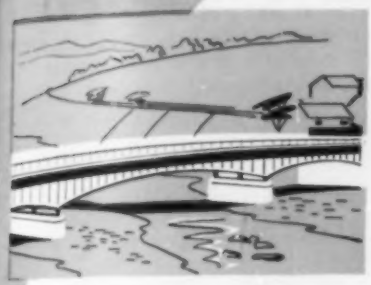
H. K. Barrows announces that he has moved his consulting office from 6 Beacon Street, Boston, to his home at 332 Highland Avenue, Winchester, Mass., where he will be available for consultation and advice.

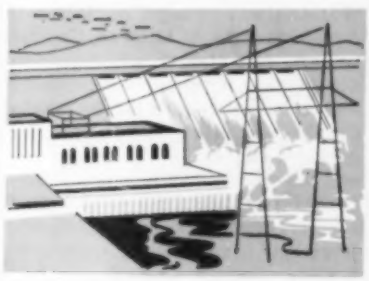
Frederick H. Dechant and **Clinton A. Robinson,** with the New York and Philadelphia consulting firm of Frederic R. Harris, Inc., have been elected to the chairmanship of the board of directors and the presidency of the firm, respectively, succeeding the late **Frederic R. Harris.**

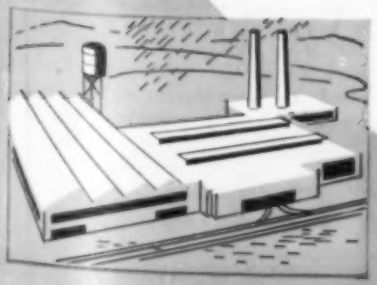
William H. Rayner and **W. L. Collins** have been advanced from associate professors to the positions of professor of civil engineering and professor of theoretical and applied mechanics, respectively, at the University of Illinois. **W. E. Hanson, Jr., Danner,** and **M. O. Schmidt** have been made associate professors of civil engineering at the same institution.

(*Continued on page 68*)









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(*Continued from page 66*)

Bernard L. Weiner announces the opening of a consulting office for the practice of civil engineering at Long Island City, N.Y., with specialties in grade separations, skew bridges, slabs, mathematical and practical analyses.

Mason Young, previously division engineer of the South Atlantic Division of the Corps of Engineers at Atlanta, Ga., has been assigned to overseas duty.

H. G. Baity, professor of sanitary engineering, University of North Carolina, Chapel Hill, is now on an assignment in South America for the Institute of Inter-American Affairs, making a study and report on the protection of bathing beaches in the city of Montevideo.

J. Wm. Grant has been elected vice-president and sales manager of the Electro-Chemical Supply and Engineering Co., of Emmaus, Pa. Mr. Grant is a specialist in acid and corrosion-proof construction.

Fremont S. Tandy has assumed a new assignment as district engineer for the Corps of Engineers in San Francisco, Calif. Colonel Tandy just completed three years of service in Latin America, with headquarters in Panama. There he organized and put into operation the Inter-American Geodetic Survey. Colonel Tandy saw active combat service in France during World War II while in the 20th Corps of the Third Army under General Patton.

Gamble M. Bowers, since 1935 public works director of Richmond, Va., is retiring after being in the employ of the city for over 40 years.

J. E. McKee has withdrawn as an active partner in the Boston firm of Camp, Dresser & McKee to accept an appointment as associate professor of sanitary engineering at the California Institute of Technology. He will act as a consultant to the firm on problems of stream-pollution investigation and industrial waste research. As an engineer officer during the Second World War, Mr. McKee served in offices of the Pacific Division at Salt Lake City, Utah, and later in combat with the First Army in Europe, attaining the rank of major.

Edward J. Kimmick has been named assistant professor of civil engineering at Illinois Institute of Technology. Mr. Kimmick received his master's degree last June at the Missouri School of Mines and Metallurgy, where he served as an instructor in civil engineering.

Deceased

Philip Edgar Bond (M. '26) consulting engineer of Holyoke, Mass., died in a hospital in that city on August 18, at the age of 55. Mr. Bond graduated from the University of Michigan in 1916 and later attended the U.S. Naval Academy, serving as an ensign in the first World War. He was city engineer of Holyoke from 1923 to 1938, and since 1926 had been a member of the Holyoke consulting firm of Tighe & Bond, specializing in sanitary and hydraulic work. Mr. Bond belonged to the Engineering Society of Western Massachusetts, the New England Water Works Association, and the New England Sewage Works Association, and was a Mason.

Sidney Kingman Clapp (M. '22) division engineer for the New York City Board of Water Supply for 40 years before his retirement in 1945, died in a Kingston, N.Y., hospital on August 15. He was 76. Mr. Clapp had been an assistant engineer on construction of the Ashokan and Gilboa reservoirs and the Catskill Mountain water supply system, and at the time of his retirement was engaged in studies on possible future water supplies for New York City. A graduate of Massachusetts Institute of Technology in 1895, Mr. Clapp had been with the Boston Water Board, the City of Waterbury, Conn., the Boston & Northern Street Railroad, and other organizations. He was a Mason, and had been commissioner of the Ulster-Greene Counties Boy Scout Council.

Charles Alton Ellis (M. '22) emeritus professor of structural engineering at Purdue University, where he was head of the department from 1934 to 1946, died in Evanston, Ill., on August 22. He was 73. A graduate of Wesleyan University, Professor Ellis had also been on the faculties of the universities of Michigan and Illinois, and in the employ of the American Bridge Co., the Dominion Bridge Co., and the Strauss Engineering Corp., of Chicago. He was author of numerous articles on bridge engineering subjects, co-designer of the Montreal Harbor Bridge, and one of several designers of the Golden Gate Bridge across San Francisco Harbor. Professor Ellis belonged to the American Concrete Institute and the American Railway Engineering Association.

Almon Lawrence Fales (M. '13) Boston consultant, died at his home in Newton Centre, Mass., on August 19, at the age of 73. Mr. Fales was connected with the Boston consulting firm of Metcalf & Eddy from 1913 until he retired as an active partner in 1948 because of poor health. He retained his connection with the firm as a consultant until his death. A sanitary engineering authority, Mr. Fales served the government in both world wars as a consultant on sewage disposal methods at army camps and on the treatment of wastes from ordnance plants. He was also adviser to many municipalities, including the Sanitary District of Chicago and the Boston Metropolitan District. A graduate of the Worcester Polytechnic Institute, class of 1898, Mr. Fales was connected with the sewage purification works of the City of Worcester for 15 years before joining the Metcalf & Eddy firm. He was the author of many articles for the technical and scientific press, and a member of the Boston Society of Civil Engineers, the American Water Works Association, the American Chemical Society, the New England Water Works Association, and the New England Sewage Works Association.

Almon L. Fales

Lawrence Filler Hanks (Assoc. M. '40) of Denver, Colo., died on June 20, at the age of 42. Following his graduation from the Colorado Agricultural College in 1929, Mr. Hanks became connected with the Bureau of Valuation of the Interstate Commerce Commission. Beginning in 1930, he was for a number of years in the Water Resources Branch of the U. S. Geological Survey, as junior engineer and assistant engineer. He had been stationed at Lincoln, Nebr., and Denver. More recently Mr. Hanks was in the army.

Alfred Laird Harvey (M. '39) chief engineer of the Tyne Improvement Commission, Newcastle upon Tyne, England, died at his home there on July 24. He was 51, and a graduate of Marlborough College and of Gonville and Caius College, Cambridge. He served as a lieutenant in the Royal Engineers in the first World War and was awarded the Military Cross. As assistant to A. C. Swan, Canadian consultant, Mr. Harvey was engaged on the development of the port of Vancouver, B. C., and on construction of the first bridge across the harbor. He had also been resident engineer on the construction of a harbor on the Saguenay River at Chicoutimi, Quebec; resident engineer for the Shoreham Harbor Trustees on lock and drydock construction; and resident engineer for the London County Council. He had been with the Tyne Improvement Commission since 1938, and chief engineer since February 1947. A member of the Institution of Civil Engineers, Mr. Harvey was currently serving as chairman of the Northern Counties Association of the organization. He also belonged to the Société des Ingenieurs Civils de France.

Abraham Lincoln Hyde (M. '97) emeritus professor of civil engineering at the University of Missouri, died on April 13. He was 85. A graduate of the Sheffield Scientific School of Yale University, Mr. Hyde was on the University of Missouri engineering staff from 1903 until his retirement in 1934. He was promoted through the various ranks, becoming chairman of the civil engineering department in 1931. Engaged in bridge engineering in his early career, Mr. Hyde detailed the four-track Harlem River swing span and designed and supervised the construction of new bridges for several railroads and a station and train shed for the Baltimore & Ohio at Cleveland. He was co-author of an engineering text on *Masonry Structures*.

(*Continued on page 72*)

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(*Continued from page 68*)

James Augustus Kelley (M. '08) retired civil engineer of Washington, D.C., died in a hospital there on July 23, at the age of 81. A resident of Washington for more than 25 years, Mr. Kelley was resident engineer there on construction of the Washington, Baltimore & Annapolis Electric Railway. Later he supervised construction work for various railroads, including the Delaware & Hudson. After service as a major in the Construction Division of the Army, Mr. Kelley returned to the Delaware & Hudson and later did railway valuation for the Interstate Commerce Commission. From 1925 until his retirement in 1939 he was in the Engineer Department of the District of Columbia.

Forest Henry Lancashire (Assoc. M. '07) of Woodlake, Calif., died on February 21, according to word just received at Society headquarters. Mr. Lancashire, who was 69, had had a consulting office in Dallas, Tex., and an extensive engineering practice in the Southwest. He was principal assistant engineer in charge of the construction of the Monterrey Railway, and later operated the line. More recently Mr. Lancashire was engaged in citrus fruit ranching in California. He was a graduate of the University of Michigan.

John Howard Lewis (Assoc. M. '05) engineer of Portland, Ore., died there on July 12, at the age of 71. In private practice since 1918, Mr. Lewis had served in the Oregon state legislature, as a member of the Port of Portland Commission, and as engineer for the Federal Public Housing Authority. Earlier in his career (1904 to 1918) he was state engineer of Oregon, and at one time he was engaged in railroad work. He was a civil engineering graduate of Cornell University.

Robert Bradford Marshall (M. '04) retired colonel in the Corps of Engineers Reserve, San Francisco, Calif., died in that city on June 21. He was 82. Beginning in 1889, Mr. Marshall was for many years in the U. S. Geological Survey, which he finally served as chief topographic engineer. At one time he supervised the mapping of the Pacific Coast states. For some years he was also state landscape engineer for the California Department of Public Works, and in World War I he served with the Army Corps of Engineers.

Adam Arthur McLintock (Assoc. M. '19) since 1942 senior adviser for Scotland with the Ministry of Works, Edinburgh, Scotland, died on August 15. His age was 62. For 16 years Mr. McLintock was with the British Phosphate Commissioners, of London and Melbourne, which he served, as resident engineer, assistant manager, and manager of mining and construction operations at Ocean Island in the Gilberts. As resident engineer for the John Galt Engineering Co., he worked on water supply and sewerage construction projects in Winnipeg, and he had engaged in similar work for the City of Edmonton, Alberta. Before joining the Ministry of Works, Mr. McLintock was chief civil engineer and superintendent for Messrs. D. C. Stewart, public works contractors of Aberdeen.

Percy Shelley Monk (M. '26) of Columbia, S.C., died in the U. S. Veterans Hospital there on August 16. Mr. Monk, who was 63, had been bridge designer for the South Carolina State Highway Department for the past ten years. Earlier he had been associate highway engineer for the Bureau of Public Roads, division engineer for the Pittsburgh Bureau of Bridges, assistant engineer for the Allegheny County (Pennsylvania) Bureau of Bridges, and assistant chief engineer of the Pittsburgh Department of City Planning. Mr. Monk was an alumnus of Cornell University, and a veteran of World War I.

Charles Eliot Nichols (M. '22) secretary of the Washington office, Merchandise Division, of the American Warehousemen's Association, died in a hospital in Washington on July 3. He was 64. An honor graduate of Harvard University, class of 1907, Mr. Nichols later did graduate work there in the Graduate School of Applied Science. From 1909 to 1932 he was with the Stone & Webster Engineering Corp., successively as draftsman, designer, and structural engineer, on engineering projects in various parts of the country. He then had a consulting structural practice in Boston, and for several years was with the Tennessee Valley Authority. He had been with the American Warehousemen's Association since 1943. Mr. Nichols' affiliations included the Boston Society of Civil Engineers, the American Concrete Institute, and the National Society of Professional Engineers.

Jack Peele, Jr. (Assoc. M. '49) major, U. S. Marine Corps, Camp Lejuene, N.C., died on July 16, 1949, at the age of 33. A graduate of the University of South Carolina, class of 1938, Mr. Peele was with the South Carolina Highway Department prior to joining the Marine Corps in 1941. During the war Major Peele served several years in the field on the construction of field emplacements and camp sites. Later, as intelligence officer for the Amphibious Forces, Pacific Fleet, he was engaged in detailed study of terrain and hydrographic intelligence for the Pacific Ocean area. Major Peele belonged to the Society of American Military Engineers.

George Morris Tompson (M. '88) civil engineer of Wakefield, Mass., died at Charlton, Mass., on July 12, at the age of 96. Following his graduation from Massachusetts Institute of Technology in 1872, Mr. Tompson spent a number of years in Mexico on the construction of railroads for the Mexican Central Railroad. His later railroad engineering experience included five years with the Boston & Lowell Railroad and nine years with the Boston & Maine. He also directed construction of a narrow-gage railroad from Boston to Revere Beach, Mass., and of the East Boston street car tunnel under Boston Harbor. Mr. Tompson was seventh on the list of veteran ASCE members, having been a full member for 61 years. For many years he was also prominent in Masonic activities.

Sutton Van Pelt (M. '14) of La Porte, Ind., died on March 25, according to word just received at Society headquarters. He was 74. As junior engineer for the U. S. Corps of Engineers from 1901 to 1909, Mr. Van Pelt was in charge of the location and planning of nine locks and dams on the Warrior River in Alabama. Later work included six years as chief construction engineer for the State of Illinois Division of Waterways; three years as construction engineer for the L. E. Myers Co. on the construction of the Oakdale, Ind., dam and power plant; and four years as construction superintendent for Wood Brothers Co. on the building of the Starved Rock Lock and Dam and the Cimarron River bridge. Since 1930 he had been in private practice. Mr. Van Pelt was a graduate of the University of Michigan and a veteran of World War I.

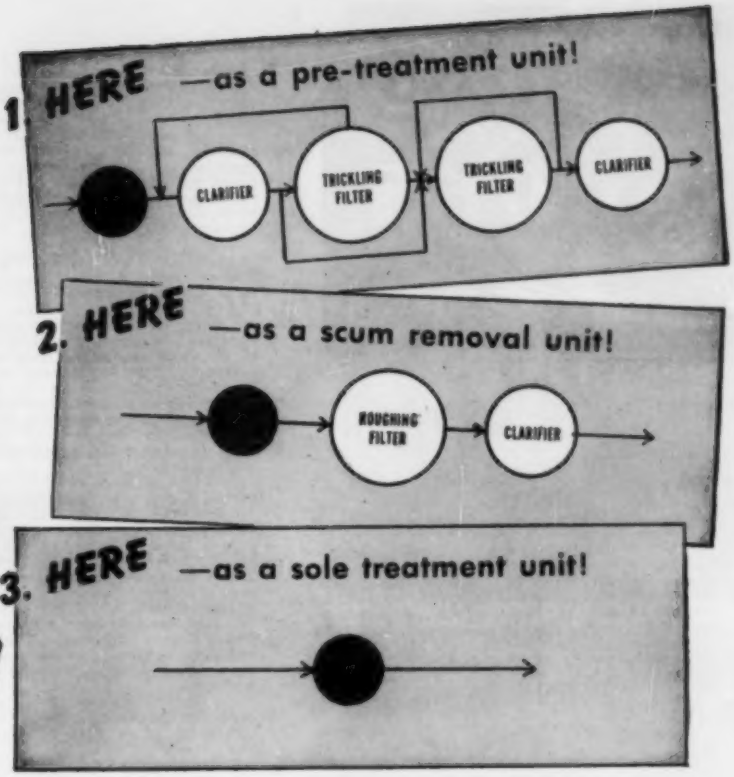
Thomas Jefferson Wilkerson (M. '10) consulting engineer of Beaver Falls, Pa., and a former ASCE Director, died at his home in Beaver Falls, Pa., on September 2. His age was 80. An authority on bridge design and construction, Mr. Wilkerson had been bridge designer for both the American Bridge Co. and the City of Pittsburgh, chief engineer for the Penn Bridge Co. at Beaver Falls, and consulting engineer for the Allegheny County (Pennsylvania) Bureau of Bridges. In the latter capacity he was in charge of the design and construction of all Allegheny and Ohio River bridges built by the county between 1924 and 1932. From 1929 on he had a consulting practice in Beaver Falls. Between his graduation from the University of Missouri in 1890 and his affiliation with the American Bridge Co. in 1901, Mr. Wilkerson was with various bridge companies. Long a member of the Society, he served as Director from 1934 to 1936, and he was one of the organizers of the Pittsburgh Section. His other affiliations included the Engineers' Society of Western Pennsylvania and the American Society for Testing Materials.

T. J. Wilkerson

Charles Anthony (M. '02) of Guernsey, Channel Islands, England, died at his home there on August 18, at the age of 83. Mr. Anthony was educated at Cambridge University, and received early engineering training in the office of James Mansergh. For much of the period between 1890 and 1902, he was in Buenos Aires engaged in sanitary engineering construction—first as a member of the staff of Bateman & Parsons and later as engineer for the City of Buenos Aires Sanitary Improvement Works Commissioners. Later he was employed on water supply engineering projects for many other South American municipalities and he served as consultant to the Cape Colonial Government in South Africa on water supply investigations and construction. Mr. Anthony was the inventor of numerous hydrological and hydraulic instruments, and had written on water supply and sanitary engineering subjects for a number of publications, including the ASCE TRANSACTIONS.

in the sewage treatment flowsheet . . .

the DORRCO VACUATOR fits



Operating on the principle of vacuum flotation within an enclosed tank, the Dorrco Vacuator produces three separate products . . . scum and flotable solids . . . grit and settleable solids . . . an effluent. It can be used in the sewage treatment flowsheet to accomplish many results under widely varying conditions . . . of which the following three are typical.

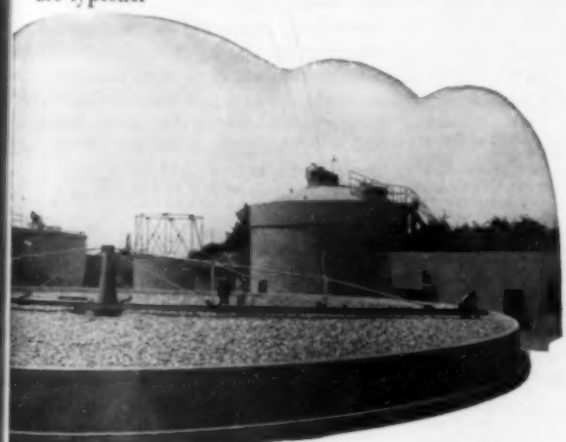
1. As a pre-treatment unit ahead of biologic treatment . . . either trickling filters or activated sludge . . . it will remove scum, grit and a substantial percentage of suspended solids in a single operation.

2. When seasonal loads of canning, packing house or other industrial waste create a scum problem, the Vacuator will relieve the overload, so that the Clarifier maintains satisfactory overall operation.

3. In coastal areas where partial treatment only is permissible, it will adequately remove visual or floating pollution.

With the Vacuator, suspended solids removal will average 40%—B.O.D. removal 25% or better. In *every* type of application the Vacuator will remove grit equalling the performance of the usual grit chamber. These facts are clearly documented by operating results from both municipal and pilot plant installations on all three applications.

A Dorr engineer will explain in detail the applications of the Dorrco Vacuator to your own problem.



Dorrco Vacuator, at right behind filter, installed at the City of Palo Alto, California, handling domestic sewage containing a heavy load of cannery waste. Average design flow, 3.0 M.G.D. . . . peak flow 6.0 M.G.D.

City Engineer: Fabian S. Miller.

Consulting Engineer: Harry N. Jenks, Palo Alto, California.

Contractor: Fred J. Early, Jr., Co., Inc., San Francisco, California.

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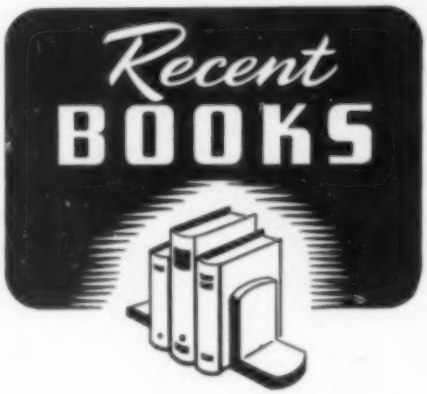
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.



BUILDING FOR DAYLIGHT. By R. Sheppard and H. Wright. Macmillan Co., New York, 1948. 91 pp., illus., diagrs., 11×8½ in., cloth, $5.50. A compact and fully illustrated survey of the methods of planning and siting buildings in relation to the admission of daylight to their interior spaces is presented in this book, which includes detailed specifications for the types of glass for various kinds of buildings—houses, schools, hospitals, hotels, and such large-scale structures as railway stations. There is an introductory historical note on the evolution of English window design.

CONSTRUCTIVE USES OF ATOMIC ENERGY. By S. K. Allison and others, edited by S. C. Rothmann. Harper & Brothers, New York, 1949. 258 pp., illus., diagrs., charts, tables, 8¼×5½ in., cloth, $3. This volume brings together 14 articles by specialists, describing the current uses of atomic energy in the fields of industrial power, chemistry, metallurgy, aviation, ceramics, soil-fertilizer research, biology and medicine, and pointing out the possibilities of future development. An appendix contains a glossary, a classified bibliography, and a chronological list of significant dates.

CONVEYORS AND RELATED EQUIPMENT, 2 ed. By W. G. Hudson. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1949. 468 pp., illus., diagrs., charts, tables, 9¼×6 in., leather, $7. This comprehensive treatment of the science of handling materials describes the application of a wide variety of equipment and analyzes the several kinds from the viewpoint of effectiveness. It provides a guide to the factors which must be considered when buying, equipping, operating, and maintaining conveyors and related devices. The new edition contains an extended discussion of pneumatic conveying.

DIFFERENTIAL EQUATIONS, 2 ed. By H. W. Reddick. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1949. 288 pp., diagrs., tables, 8½×5½ in., cloth, $3. Methods of solving ordinary differential equations and related problems in applied mathematics are covered in this volume, which stresses the importance of the physical units involved. Changes in this second edition include a new chapter on the linear equation of the second order and additional material on hyperbolic functions, systems of curves, and vibratory motion.

ENGINEERING ECONOMICS AND PRACTICE, INCLUDING SOLUTIONS TO PROBLEMS IN PROFESSIONAL ENGINEER EXAMINATIONS, NEW YORK STATE. By M. J. Steinberg and W. Glendinning. Apply W. Glendinning, 5123 Bell Boulevard, Bayside, N.Y., 1949. 101 pp., diagrs., charts, tables, 11½×8½ in., paper, $3. Basic principles of engineering economics and practice are covered in this work. The principles have been reduced to a formula basis with each of the terms clearly defined. Each chapter includes problems of a practical nature that illustrate the principles involved. Questions and solutions to the problems in engineering economics and practice from the New York State professional engineering examinations are an important supplement to the text material.

FLOW IN CONDUITS AND CANALS. (Engineering Institute of Canada, Technical Paper No. 1). By R. DeL. French and F. M. Wood. Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Canada, 1949. 13 pp., 15 charts, 11×8½ in., paper, apply. This publication provides, with explanations of their use, tables and charts for expediting and simplifying some common and frequent hydraulic calculations in connection with flow in conduits and canals—for example, a chart for the Hazen and Williams' formula, a chart for converting Kutter's "n" to Hazen and Williams' "C," etc.

HYDROELECTRIC ENGINEERING. By G. Gerard. Sir Isaac Pitman & Sons, Ltd., London, 1949. 181 pp., illus., diagrs., charts, maps, tables, 8½×5½ in., cloth, 20s. Written from the practical angle, this book outlines the civil, mechanical, and electrical aspects of hydroelectric engineering. To illustrate certain of the principles touched on, an appreciable space is devoted to descriptions of typical hydroelectric plant and schemes in operation in various parts of the world.

MODERN RAILROAD STRUCTURES. By C. P. Disney and R. F. Legget. McGraw-Hill Book Co., New York, Toronto, London, 1949. 213 pp., illus., diagrs., charts, tables, 10½×7¼ in., cloth, $5. This book is an illustrated record of recent advances in the design and construction of the more important structures required for railroads. The importance of soil mechanics in railroad engineering is stressed, modern methods of treating railroad track are described, and recent improvements in the art of grouting and repairing concrete and masonry work are fully covered. The most extensive treatment is given to bridge types.

MODERN TIMBER ENGINEERING, 3 ed. By W. F. Scofield and W. H. O'Brien. Southern Pine Association, New Orleans, La., 1949. 147 pp., diagrs., charts, tables, 9¼×6 in., fabrikoid, $1.50. Intended both as a textbook for students and a reference book for practicing architects and engineers, this publication deals with the characteristics of wood, fastenings, beams, columns, trusses, floor systems, and other pertinent topics. Diagrams, worked-out examples, and data tables add to the practical value of the work. Specifications conform to standard building codes.

MUNICIPAL ENGINEER. By L. B. Escritt. Macmillan Co., New York; George Allen & Unwin Ltd., London, 1949. 252 pp., diagrs., maps, tables, 7½×4¾ in., cloth, $2. Intended for those now in or desiring to enter a municipal engineering department, this book, written from the British point of view, describes in detail the working of the department. It outlines the scientific processes involved in road construction, water supply, and sewerage, and discusses the relations of these environmental services to town planning.

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

PLAIN CONCRETE, 3 ed. By E. E. Bauer. McGraw-Hill Book Co., New York, Toronto, London, 1949. 441 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $5. Giving the undergraduate engineering student a professional background in the field of concrete, this book presents a thorough discussion of the fundamental problems of concrete production together with instructions for the performance of laboratory tests. Changes in this third edition include new material on air-entraining portland cements, air-entraining mixtures, the measurement of the amount of air entrained in concrete, and latest statistical data and specifications.

PRINCIPLES AND PRACTICE OF PRESTRESSED CONCRETE. By P. W. Abeles. Crosby Lockwood & Son, Ltd., London, England, 1949. 109 pp., illus., diagrs., charts, tables, 10×7½ in., cloth, 15s. This book, based on a series of articles in the British magazine, *Civil Engineering and Public Works Review*, gives a full account of the history of prestressed concrete, the various systems of prestressing and methods of tensioning. The author reports on several groups of tests, compares "full" and "partial" prestressing, and describes in detail various practical applications of "pre-tensioning" and "post-tensioning."

WORK OF THE SANITARY ENGINEER, based on original work by A. J. Martin, rewritten and enlarged by L. B. Escritt and S. F. Rich. Macdonald & Evans, London, W. C. 1, 1949; available through American Agent, Edward W. Sweetman, 1 Broadway, New York 4, N.Y.; 689 pp., illus., diagrs., charts, tables, 10×6 in., cloth, 42s. Intended equally for the practical designer, the administrator, and the student, this British textbook presents detailed practical information on water supply, building sanitation, sewage and land drainage, sewage treatment and disposal, and public cleansing. In view of the importance of legal and administrative knowledge to those concerned with municipal work, a 60-page section covering these aspects has been included.

Size of Airport Program Summarized by ARBA

THE COUNTRY'S AIRPORT PROGRAM co... stitutes a substantial segment of public co... struction, "even though it may not be ... glamorous as it was once regarded," accor... ing to a recent issue of *Out at the Airp...* publication of the Airport Division of t... American Road Builders Association. R... sponding to inquiries as to the actual stat... of airport construction, the publicati... states that the "development of airfi... has settled down, becoming almost routine."

In support of its statement, it cites t... fact that "the Federal-aid Airport Progra... which was put under way only slightly mo... than two years ago, now involves develo... ment of more than 830 airport projects. Construction of 339 of these projects, at 2... locations, had been completed as of July ... and many others were in varying stages ... completion, including 173 that were fro... 76 to 99 percent finished. Only 158 had no... been started, and the publication states th... work has since begun on a number of the... projects.

Moreover, it continues, "the federal-a... phase of airport building is not the on... source of funds for such construction; d... velopment of numerous airports is goi... forward at many locations without federa... assistance. Including carry-over of 19... federal-aid funds, the 1949 program invol... ing federal-aid projects is estimated ... $110,000,000. This does not take in... account funds expended on non-federal-a... civil airport projects during the war. Th... total 1949 airport program, in dolla... volume, is estimated to be $205,000,000."

Despite the size of this program, the cu... rent National Airport Plan foresees the ne... for even greater development during th... next three years, the publication points out... stating that the Civil Aeronautics Adminis... tration's forecast of such needs during th... next three years calls for building 2,794 ne... airports and improving 2,183 existing air... fields. The estimated cost of these 4,97... developments is $1,115,300,000.

Film Shows Flood Control Operations on Mississipp...

PRODUCTION OF A 16-mm sound film i... color, showing the construction of levee... cutoffs, and revetments, and channe... dredging operations on the Mississip... River, has recently been completed in th... Office of the President of the Mississip... River Commission. Scenes of the 19... flood in the lower Mississippi Valley, flood... fighting activities, and flood-relief work ar... also depicted in the film, which runs 2... minutes.

Copies of the film, entitled "The Valley ... of the Giant," will be available for trainin... student engineers. Inquiries should b... addressed to the Office of the President o... the Mississippi River Commission at Vicks... burg, or to the offices of the District Engi... neers at Memphis, Vicksburg, and New... Orleans.

3. Soil corrosion:

Two factors give Transite Pressure Pipe exceptional resistance to corrosion: (1) the corrosion-resistant materials of which it is made; (2) the especially developed Johns-Manville process of manufacture which imparts a high degree of chemical stability to the finished pipe. This high resistance to corrosion has been substantiated by numerous installations. Many of these are serving as replacements in soils so destructive that the useful life of the pipe materials previously used had been seriously curtailed.

4. Internal corrosion:

Transite Pipe, because of its asbestos-cement composition, is not affected by tuberculation. Therefore, it is not necessary to resort to pipe of larger diameter to offset the internal effects of this costly form of pipe corrosion. And because progressive reduction of delivery due to tuberculation capacity is never a problem in a Transite pipe line, pressures and flows remain high—pumps operate at higher efficiencies. These factors are often reflected in better service and lower water rates in communities served by Transite lines.

5. Joint leakage:

Transite's Simplex Coupling was designed to minimize underground leakage . . . and to provide maximum protection against failures resulting from trouble at joints. It consists of only three parts: a Transite sleeve, machined to fit over the pipe ends, and two rubber rings which, when assembled, are tightly compressed between pipe and sleeve. The joint thus formed is tight and flexible. It remains tight in service. Furthermore, each joint may be checked for proper assembly immediately upon completion.

6. Vibration and stresses:

Transite's flexible joints effectively absorb the vibration of heavy traffic—an especially important factor where pipe is laid under busy highways, or near railroad and street car tracks. Because each joint is capable of deflection up to five degrees, the entire line has a flexibility not ordinarily found in other types of waterline construction. This helps compensate for soil movements and other stresses to which the pipe may be subjected . . . provides an effective safeguard against costly pipe failures.

7. Maintenance:

In thousands of communities, Transite Pipe—with its advantages of joints that remain tight and flexible, its corrosion resistance, and immunity to tuberculation—provides low-cost water transportation that requires little, if any, maintenance. Transite lines do not have to be cleaned, lined, or replaced because tuberculation has reduced their original capacity. Reports from communities all over the country prove that Transite's asbestos-cement structure provides economies that continue through the years.

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Johns-Manville Transite Pressure Pipe

Meetings and Conferences

American Concrete Institute. The Boston regional convention of the American Concrete Institute has been postponed from November 3 and 4 to November 10 and 11 to avoid conflict with the ASCE Fall Meeting.

American Institute of Chemical Engineers. A meeting of the American Institute of Chemical Engineers is scheduled for the Hotel William Penn, Pittsburgh, Pa., November 7 through 10.

American Institute of Electrical Engineers. The Midwest general meeting of the American Institute of Electrical Engineers will be held in Cincinnati, Ohio, October 17–21.

American Institute of Mining and Metallurgical Engineers. Various aspects of drilling and production technology will be discussed during the annual meeting of the petroleum branch of the American Institute of Mining and Metallurgical Engineers, at the Plaza Hotel, San Antonio, Tex., on October 5–7.

American Management Association. Ways and means of effecting a reduction of costs in office management are to be emphasized at the office management conference of the American Management Association, Hotel Statler, New York, N.Y., October 20 and 21.

American Public Health Association. Extensive scientific sessions are scheduled for the 77th annual meeting of the American Public Health Association, to be held at the Hotels Statler and New Yorker, New York City, October 24–28.

American Society of Mechanical Engineers. Headquarters for the annual meeting of the American Society of Mechanical Engineers will be the Hotel Statler, New York City, November 27 through December 2.

American Society of Planning Officials. The national planning conference of the American Society of Planning Officials with the American Institute of Planners cooperating, is scheduled for the Statler Hotel, Cleveland, Ohio, October 9–12, inclusive.

American Society for Metals. "Economy in production" will be the theme of the 31st annual metal congress and exposition of the American Society for Metals, at the Cleveland Public Auditorium, October 17–21.

American Standards Association. The annual meeting of the American Standards Association is scheduled for the Waldorf-Astoria, New York, N.Y. October 11–14.

American Water Works Association. Headquarters for the California section meeting of the American Water Works Association will be the Municipal Auditorium, Sacramento, October 26–28.

American Welding Society. In conjunction with the national metal exposition at the Cleveland Public Auditorium, the American Welding Society is holding its annual meeting at the Hotel Cleveland, Cleveland, during the week of October 17. Welding and cutting demonstration will be featured at the exposition.

Engineers' Council for Professional Development. Featuring a full program of technical sessions and social activities, the annual meeting of the Engineers' Council for Professional Development will take place at the Edgewater Beach Hotel, in Chicago, October 28 and 29. Inquiries should be addressed to George G. Lamb, Technological Institute, Northwestern University, Evanston, Ill.

Engineers' Society of Western Pennsylvania. The annual water conference of the Engineers' Society of Western Pennsylvania is scheduled for the Hotel William Penn, Pittsburgh, On October 17–19.

Industrial Management Society. Prominent industrial executives, plant operators and supervisors, will discuss methods and means of winning the "cold war" on industrial inefficiency during the sessions of the Management Clinic, sponsored by the Industrial Management Society, at the Sherman Hotel, Chicago, November 2–4.

National Safety Council. The Construction Section of the National Safety Council congress and exposition will hold its meeting in Chicago, Ill., at the Stevens Hotel, October 25 and 26.

Pacific Industrial Conferences. A potential for Western processing industry is to be the main topic of discussion of the Pacific Industrial Conferences, which will run concurrently with the Pacific Chemical Exposition, at the San Francisco Civic Auditorium, November 1–5.

The Seventh of a Series in the interest of more efficient use of steel . . . a vital American resource

For the BEST ANCHORAGE don't put "square pegs" in "round holes"

Maximum annular grip develops when concrete set uniformly around a circular section.
Square reinforcing bar corners break the normal annular gripping of steel by the concrete.

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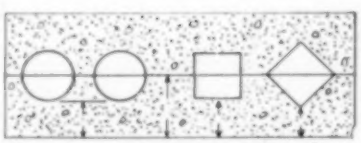
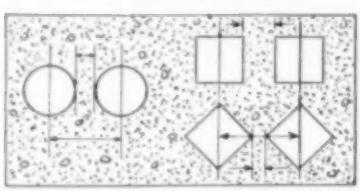
The advanced design of Laclede Multi-Rib Bars rolled to A.S.T.M. A 305-47T specification with round bar sections in all sizes assures improved anchorage with uniform concrete cover. Multi-Rib Bars have a high safety factor by combining anchorage ability well in excess of the A.C.I. recommendation of .10 fc with 65,000 p.s.i. yield point steel.


Round bar sections assure uniform clearance and coverage by the concrete.


Round bar sections space evenly and preclude the possibility of splitting due to poor coverage.

Write us about specifying LACLEDE MULTI-RIB BARS on your jobs.

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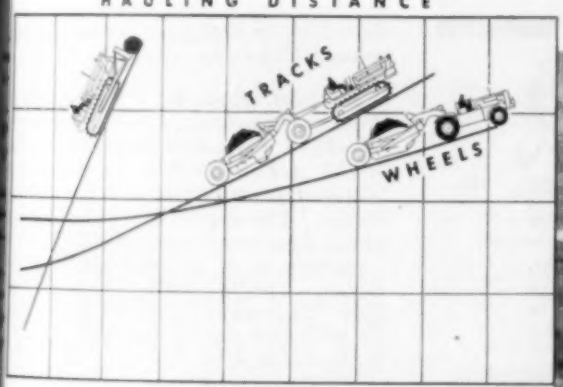
PAYS OFF IN THE COLUMBIA GORGE

Building a section of highway through the Columbia River Gorge near Arlington, Oregon, Rogers Construction Co., of Portland, has standardized on "Caterpillar" equipment.

The line-up includes a "Caterpillar" No. 28 Ripper to loosen the lava rock, D8 Tractors with No. 8A Bulldozers and No. 80 Scrapers, DW10 Tractors pulling W10 Wagons on the longer hauls, and a No. 12 Motor Grader for maintaining haul roads. In all, 30 of the big yellow machines are on this job, zoned to pay off in big production at low cost.

▲ "Caterpillar" Diesel D8 Tractors and No. 80 Scrapers scalping topsoil off the right of way. Features of the No. 80 Scraper are its 18-heaped-yard load capacity—easy loading due to good blade angle and bowl proportions—'dozer-type ejection—high apron lift—open-top bowl—big-tire handling ease and low over-all maintenance.

Rolling on rubber, the "Caterpillar" Diesel DW10 Tractor makes time on long hauls, traveling at speeds up to 24.5 mph, with 14 cubic yards on the W10 Wagon. Features of this productive team are balanced design, big tires, air brakes, booster steering, and hydraulically controlled windrowing of the dump. ▼



WATCH YOUR ZONING POINTS

Zoning points depend on grades, size of scrapers, loading methods and character of job. Too long a stretch for tracks is costly. So is too short a haul for wheels. In sound zoning it pays to standardize on "Caterpillar." Only "Caterpillar" offers a complete line of Earthmoving Equipment.

1. Track-type Tractors and 'Dozers for "push" distances.
2. Track-type Tractors for loading and pulling scrapers on medium hauls.
3. Wheel-type Tractors for high-speed hauls—plus Motor Graders for finishing and haul-road maintenance.

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DIESEL ENGINES • TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT

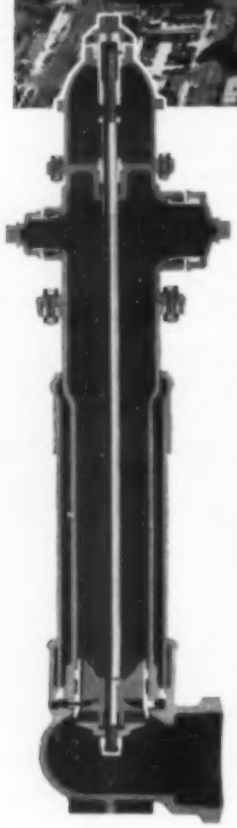
New Publications

Highway Research. Results of surfacing experiments made on the Road Test Track at Majherhat, Alipore, Calcutta, during the period 1935–1941, are summarized in Road Research Bulletin No. 1 of the Indian Roads Congress. Copies sell for 5 rupees, upon application to the Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi, India.

Engineering Employment. A 40-page brochure, entitled *Meet the Administrative Engineer*, was prepared by senior engineering students at New York University in order to introduce the 1949 graduates to industries having need of that type of personnel. Requests for copies should be directed to the Employment Board, Department of Administrative Engineering, New York University College of Engineering, Bronx 53, New York.

Hydraulics. A study of flow in conduits and canals, by R. D. French and F. M. Woods, members of the Engineering Institute of Canada, has been issued as Technical Paper No. 1 by the EIC. The principal emphasis of the publication is on charts, which have been especially prepared "to expedite and simplify some common and frequent hydraulic calculations." Copies may be obtained at cost from the General Secretary, Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2, P.Q.

Government Organization. Organiza... of the government as of July 1, including t... newest agency, the General Services A... ministration, is pictured in the newly r... leased *United States Government Organi... tion Manual*. The 725-page publicati... describes both the official and quasi-offic... agencies in all three branches of the gover... ment and of 15 selected internation... organizations. Also included are a subje... index, an index of government officials, ... section on agencies abolished or transferr... since March 1933, and a list of seve... hundred representative publications ... federal agencies. Compiled by the Divisi... of the Federal Register in the Nation... Archives Establishment, the manual ma... be purchased for $1 a copy from the Supe... intendent of Documents, Government Pri...



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THE MATHEWS

They back up their state... Modernized Hydrants us... ever you see Mathews,

Mathews Modernized ... simplicity of design. All ... a removable barrel. The ... by an iron shield opera... wrench wear. The operating thread is not exposed to water—is protected from sand and grit. The stuffing box plate, cast integral with the nozzle section, is strong, safe and leakproof. The simple, rugged construction of the Mathews offers the utmost dependability and the least in maintenance requirements.

When broken in a traffic accident, a Mathews need be out of service only so long as it takes to replace the barrel with a spare—a matter of minutes. And a damaged Mathews means no loss of water, because the main valve opens *against* the pressure.

Send for our illustrated booklet and see how Mathews Modernized Hydrants can contribute to the safety of your community.

OTHER MATHEWS FEATURES: Head can be turned 360° • Replaceable head, nozzle outlets easily changed • Nozzle levels easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be oiled • A modern barrel makes any Mathews Hydrant good as new

MATHEWS HYDRANTS

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without charge.

Housing Program. Data on the gover... ment's role in housing as well as informati... on housing activities in general are summa... rized in the Second Annual Report of th... Housing and Home Finance Agency. Spe... cific details of the programs and activities o... the Home Loan Bank Board, the Federa... Housing Administration, and the Public ... Housing Administration are also included i... the 370-page report, which is for sale by th... Superintendent of Documents, U.S. Govern... ment Printing Office, Washington 25, D.C., ... at 75 cents each.

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Aerial Survey Methods Solve Highway Location Problems

(Continued from page 44)

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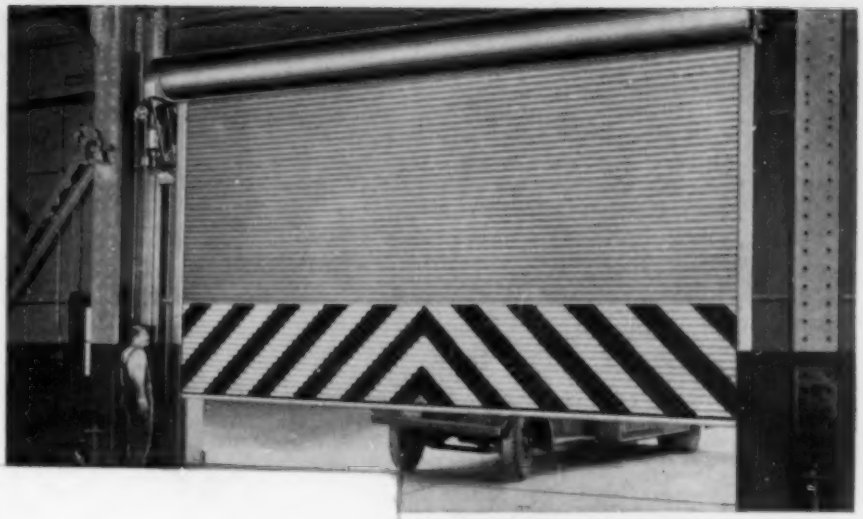

easy to see why Kinnear Rolling Doors so many cost-cutting, time-saving ad- ages. They open straight upward and coil a small area above the doorway. As a lt, all floor, wall and ceiling space around opening is *fully usable at all times.* No s need to be reserved for door action. n opened, the doors clear the entire door- They stay completely out of the way, from damage by wind or vehicles.

long with this high efficiency and con- ience, you get a bonus of all-around pro- ion and low-maintenance service. The ng but flexible *Kinnear-originated* curtain nterlocking steel slats gives extra protec- against fire, wind, riot, intrusion, and dental damage. Kinnear Rolling Doors built to fit any openings in old or new ldings. Motor or manual control. Write details.

REMOTE CONTROL

In addition to push-button controls at the doorway, others may be added, at any number of convenient points, on motorized Kinnear Doors.

KINNEAR ROLLING DOORS

THE KINNEAR MANUFACTURING CO.

Factories: 1080-90 Fields Ave., Columbus 16, Ohio
1742 Yosemite Avenue, San Francisco 24, Calif.
Offices and Agents in all Principal Cities

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character of excavation and embank- ment, how well the highway fits the topography and the surroundings, number of contract items, total cost of construction, right-of-way required and its cost. In this stage of the highway location the aerial photographs are used to the fullest extent possible.

Complete Set of Plans Made

Once the best location for the highway has been determined within the "preliminary line" zone as surveyed, the alignment, curvature and joining tangents are accurately computed and the results are recorded on the topographic map. All other computations necessary for preparation of a complete set of highway plans are made, including profile grade line, drainage structures, bridges, and schedule of construction items, including quantities and cost. The highway location is now ready to be staked on the ground.

The fourth stage is the location survey—the actual staking on the ground in readiness for construction—a task with which all highway engineers are familiar (Fig. 5).

Recommended Procedure Summarized

Summarizing, aerial surveying for highway location should be planned and conducted in a series of coordinated steps. The information obtained and properly used in each stage provides the results needed for the work in the succeeding stage. Such methods enable each highway engineer specialist to work effectively on the highway engineering team because he has the right kind and amount of information at the proper time. Continued improvement in methods of aerial surveying will no doubt increase the work that can be accomplished by aerial means and further reduce the cost of making highway locations with the aid of aerial surveying.

New Publications

Highway Research. Results of surfacing experiments made on the Road Test Track at Majherhat, Alipore, Calcutta, during the period 1935–1941, are summarized in Road Research Bulletin No. 1 of the Indian Roads Congress. Copies sell for 5 rupees, upon application to the Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi, India.

Engineering Employment. A 40-page brochure, entitled *Meet the Administrative Engineer*, was prepared by senior engineering students at New York University in order to introduce the 1949 graduates to industries having need of that type of personnel. Requests for copies should be directed to the Employment Board, Department of Administrative Engineering, New York University College of Engineering, Bronx 53, New York.

Hydraulics. A study of flow in conduits and canals, by R. D. French and F. M. Woods, members of the Engineering Institute of Canada, has been issued as Technical Paper No. 1 by the EIC. The principal emphasis of the publication is on charts, which have been especially prepared "to expedite and simplify some common and frequent hydraulic calculations." Copies may be obtained at cost from the General Secretary, Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2, P.Q.

Government Organization. Organiza... of the government as of July 1, including ... newest agency, the General Services A... ministration, is pictured in the newly r... leased *United States Government Organi... tion Manual*. The 725-page publicati... describes both the official and quasi-offi... agencies in all three branches of the gove... ment and of 15 selected internati... organizations. Also included are a subj... index, an index of government officials, ... section on agencies abolished or transfer... since March 1933, and a list of seve... hundred representative publications ... federal agencies. Compiled by the Divis... of the Federal Register in the Nation... Archives Establishment, the manual ma... be purchased for $1 a copy from the Sup... intendent of Documents, Government Pri... ing Office, Washington 25, D.C.

Construction. A panel discussion on th... utilization of engineering in construction ... presented by five outstanding contractors ... the 1948 fall meeting of the Society's Mi... South Section, have been issued as Bulleti... No. 1 of the University of Mississippi Scho... of Engineering. A foreword to the brochu... stresses the necessity of cooperation betwe... the two branches of the profession, an... states that the material is published as a ... service to the contractor, the young engine... seeking a career, and the practicing civil en... gineer engaged as the owner's agent on co... struction work. Participants in the pan... discussion were B. J. Fry, E. E. White, an... D. W. Winkelman, Members ASCE, an... T. J. Denton and N. L. Teer, Jr., with F. E... Kellogg, M. ASCE, chairman of the civil en... gineering department, acting as moderato... Requests for copies should be sent to th... School of Engineering, University of Mis... sissippi, University, Miss.

American Standards. More than 140 ne... American standards, approved since Janu... ary of this year, are included in the midyea... list of standards and special publication... just issued by the American Standards Asso... ciation. The new list offers a complete se... of all American Standards at $250 and a ... complete set of all Safety Standards a... $37.50. The 28-page list can be obtained ... from the American Standards Association, ... 70 East 45th Street, New York 17, N.Y., ... without charge.

Housing Program. Data on the govern... ment's role in housing as well as informatio... on housing activities in general are summa... rized in the Second Annual Report of the ... Housing and Home Finance Agency. Spe... cific details of the programs and activities o... the Home Loan Bank Board, the Federal ... Housing Administration, and the Public ... Housing Administration are also included in ... the 370-page report, which is for sale by the ... Superintendent of Documents, U.S. Govern... ment Printing Office, Washington 25, D.C., ... at 75 cents each.

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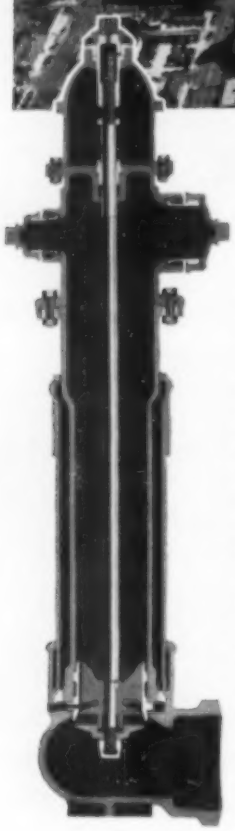

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Highway Located on Topographic Map

Whether the preliminary survey is made by ground or aerial methods, the highway location is carefully laid out on the topographic map which has been prepared to large scale on an accurate coordinate grid. This is done by use of a spline line (Fig. 4), and as the work progresses the aerial photographs are studied constantly by stereoscopic methods to obtain the wealth of information which cannot be shown on any map. The scale of the topographic map used is usually 1:1,000 (or 100 ft = 1 in.) or 1:500 (or 50 ft = 1 in.). See Fig. 1. The contour interval ranges from 2 to 20 ft (or from ½ to 5 meters) as desired, depending on the ruggedness of the topography.

Several locations are tried on this map of route topography, for comparing alignment, profile grade line, cross sections, sizes of bridges and drainage structures, quantity and the character of excavation and embankment, how well the highway fits the topography and the surroundings, number of contract items, total cost of construction, right-of-way required and its cost. In this stage of the highway location the aerial photographs are used to the fullest extent possible.

Complete Set of Plans Made

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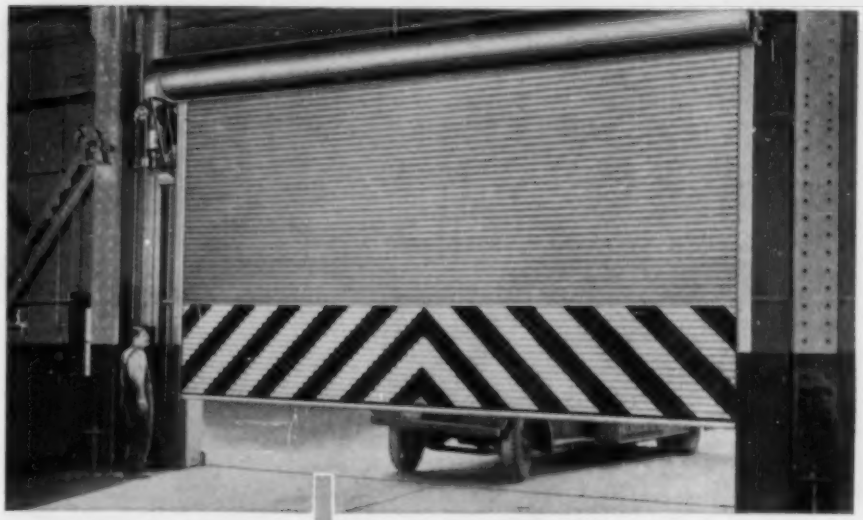


KINNEAR STEEL ROLLING DOORS

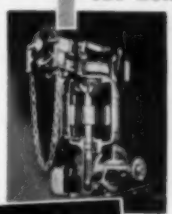
Space-Saving Convenience Plus a Bonus In Protection

It's easy to see why Kinnear Rolling Doors offer so many cost-cutting, time-saving advantages. They open straight upward and coil into a small area above the doorway. As a result, all floor, wall and ceiling space around the opening is *fully usable at all times.* No areas need to be reserved for door action. When opened, the doors clear the entire doorway. They stay completely out of the way, safe from damage by wind or vehicles.

Along with this high efficiency and convenience, you get a bonus of all-around protection and low-maintenance service. The strong but flexible *Kinnear-originated* curtain of interlocking steel slats gives extra protection against fire, wind, riot, intrusion, and accidental damage. Kinnear Rolling Doors are built to fit any openings in old or new buildings. Motor or manual control. Write for details.

MOTOR OPERATION

The rugged Kinnear Motor Operator shown at right can be added to any Kinnear Rolling Door for maximum speed, ease, and convenience of operation.



REMOTE CONTROL

In addition to push-button controls at the doorway, others may be added, at any number of convenient points, on motorized Kinnear Doors.

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Men Available

CHIEF ENGINEER, ADMINISTRATIVE ASSISTANT, MANAGER; Assoc. M. ASCE; registered professional engineer; M.S. in C.E.; 41; married; 17 years' experience, including 10 years with present employer in executive position heading large public works design, construction, maintenance, and operating organization. Present position permanent but desires new permanent connection in South, Midwest, West. C-525.

GRADUATE ENGINEER; Assoc. M. ASCE; graduate of M.I.T.; 26 years' general construction experience. Qualified as construction superintendent, resident engineer, or owner's representative on construction of airports, bridges, piers, foundries, industrial plants, warehouses, or development. Desires permanent position in U.S. C-526.

CIVIL ENGINEER; Jun. ASCE; 25; single; veteran. BSE., University of Michigan, structural option; graduate work in structural design and indeterminate analysis. Desires position with structural engineering firm. Prefers metropolitan New York. C-527.

CIVIL ENGINEER; Jun. ASCE; 31; married; Lic. P.E. N.Y.; 8 years' experience administration, design and construction, U.S. Navy Civil Engineering Office, for 6 years. Interested in office or field position, prefers sanitary engineering. Résumé furnished. C-528.

PLANT ENGINEER; Assoc. M. ASCE; C.E.; P.E. N.Y.; 38; married, 21 years' experience includes design and construction of industrial plants with particular knowledge of chemical and food processes and their related equipment. Have directed erection of large industrial projects from layout to production runs. C-529.

CIVIL ENGINEER; Jun. ASCE; BCE at Brooklyn Polytechnic Institute, 1947; 23; married; two years' general construction experience, chief of party, quantity take-off and supervision of construction. Desires employment with established construction firm. Conscientious and willing to learn. Prefers North or Middle Atlantic location. C-530.

CIVIL ENGINEER; Assoc. M. ASCE; M.S., 1938; 39; experienced in steel and concrete design, industrial buildings, bridges, etc. Four years Engineer Officer, U.S. Marine Corps. Desires position in U.S. C-531.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Positions Available

ENGINEERS. (*a*) Project Manager, either civil, electrical, or mechanical graduate. Must be an exceptionally good administrator, to take complete charge of the erection of a 200,000-kw steam electrical power plant in India. Salary, $18,000 a year, plus all traveling and living expenses. Three-year contract. Y-2622.

CIVIL ENGINEER, 35–45, to supervise project engineers on building work, waste disposal, and general civil engineering design for chemical company located in the East. Write stating experience, education, and salary requirements. Y-2690.

ENGINEERS. (*a*) Architect, graduate, with substantial experience in layout work and architectural design of industrial buildings and capable of carrying out assignments with a minimum of supervision. (*b*) Structural designer, civil graduate, with considerable experience in the design of structural steel and reinforced concrete structures, to design and lay out industrial buildings. Salaries open. Location, Massachusetts. Y-2720.

ELECTRICAL, CIVIL AND MECHANICAL ENGINEERS, 30–35, with 3 to 5 years' experience in oil refinery design and construction, to perform staff engineering assignments and supervise estimating, designing, and construction of town sites, public utilities, and oil refinery process equipment. Salary, $6,300 a year plus bonus. Family housing available sometime in the future, therefore, must go single status for an indefinite period. Location, Venezuela. Y-2741.

MUNICIPAL ENGINEER, preferably civil graduate, with license, and at least 5 years' actual experience in municipal public works and engineering, to act as consultant to city officials regarding engineering standards and specifications, analysis of costs and development of standards of performance, determination of equipment needs, and application of approved public works practices generally, including surveys and preparation of reports, manuals, etc., of general use and practical benefit to local municipal officials. Salary, $4,200–$5,000 a year. Location, Southern State University. Y-2757.

STRUCTURAL DESIGNER, civil graduate, with at least 10 years' concrete design experience, for the design of reinforced concrete arch bridges. Must be a member of the ASCE. Location, Massachusetts. Y-2774.

JUNIOR ENGINEER, 25–30, civil graduate, with master's degree in city planning, or at least a year's experience in city planning, to assist in making surveys, layouts, etc., in connection with planning and improvements. Salary, $4,000 a year. Location, New York, N.Y. Y-2779.

DESIGNER, graduate civil engineer, well experienced in reinforced concrete design, with thorough knowledge of soil mechanics, and well versed in concrete arch analysis and moment distribution as applied to underground continuous concrete structures. Salary, $5,000–$6,000 a year. Location, Chicago or vicinity. R-5845.

RECENT GRADUATE, Civil Engineer or Architect, a good draftsman and well informed on the elements of reinforced concrete foundations, structural design and reinforcing steel, and able to prepare working drawings. Salary, $3,000 a year. Location, Chicago, Ill. R-5853.

(*Continued on page 84*)

POSITION VACANT

STRUCTURAL DRAFTSMAN

Major oil company in New York City wants experienced structural draftsman and engineer to design and detail miscellaneous structures, wharfs, etc. Permanency and advancement available to right man. Give full particulars on age, education, experience and salary expected.

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THE WELLPOINT BUSINESS

Engineering degree preferable, with experience on heavy construction and wet excavations. Must be able to read and prepare sketches for final plans. Prefer men with sales personality, under 40 years of age.

2 Positions Available—1 New York District to cover Eastern seaboard states, 1 Chicago District, to cover Mid-western States.

Send snapshot, resume, and advise salary desired.

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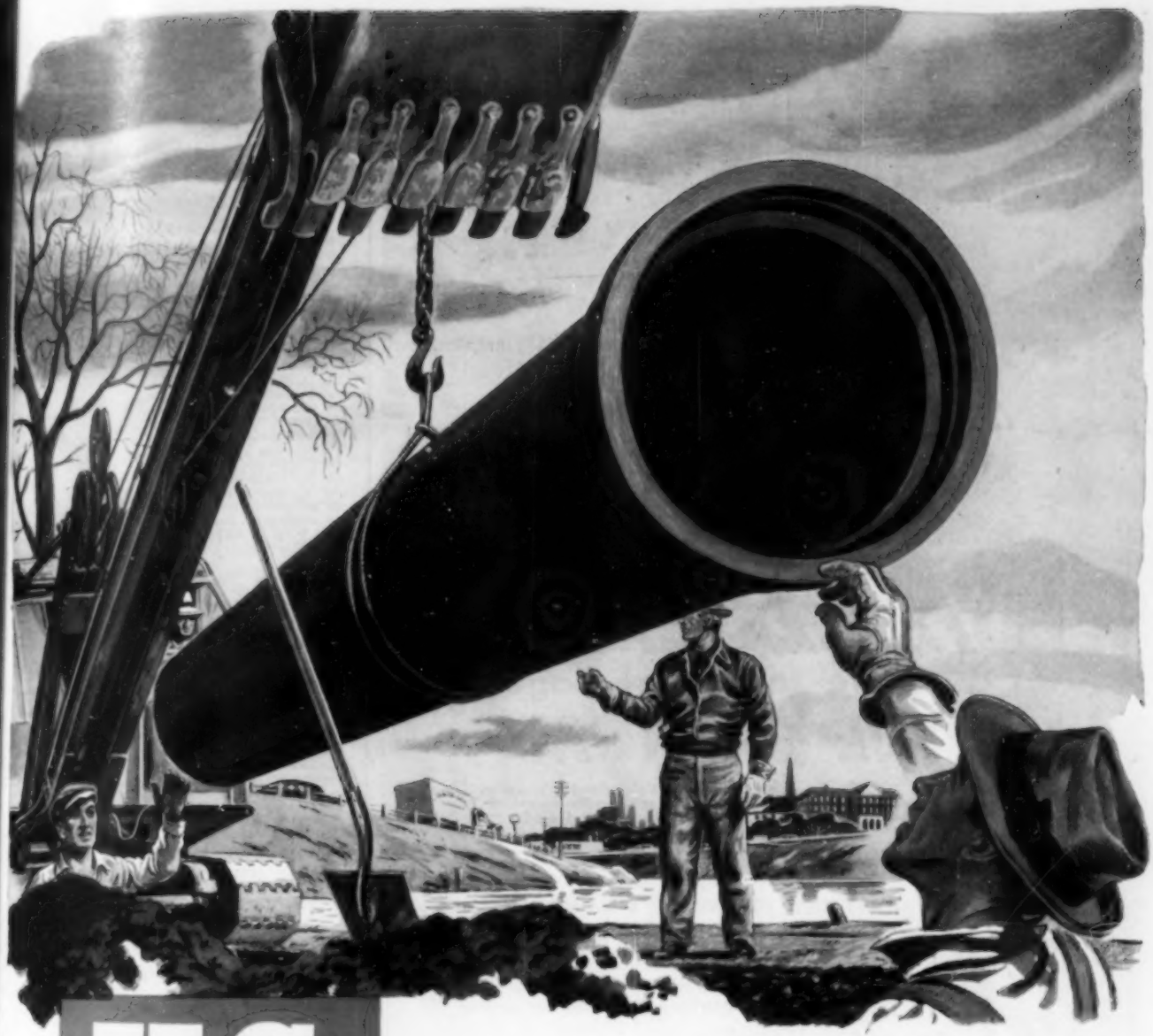

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THE quality of U. S. Cast Iron Pipe is controlled to a degree undreamed of by pipe founders a generation ago. Before the molten metal is poured into the mold of a Super-deLavaud centrifugal casting machine the important characteristics of the iron have been determined by our metallurgists. After the pipe has been cast our plant and research laboratories conduct numerous tests, in addition to acceptance tests, to assure the maintenance of quality in U. S. Pipe. This routine procedure at our several plants is enforced so that *we* may be confident that *your* confidence in our product continues to be justified. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey, Plants and Sales Offices Throughout U. S. A.**

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Your exact requirements—packaged complete and ready to go for
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by one unskilled man with a wrench!
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Brooklyn 11, New York
CABLE: PIPESUPPLY

(Continued from page 82)

DESIGNERS. (a) Designer, structural, graduate C.E., 27–33; several years' experience with reinforced concrete for consulting engineer, contractor, or as a teacher. Should have practical working knowledge. Will be concerned with collection, collation, preparation, and dissemination of information dealing with concrete designs. Salary, $4,200–$5,100 a year. (b) Designer, concrete, master's degree, 27–33, with qualifications as above. Location, Chicago, Ill. R-5882.

ASSOCIATE PROFESSOR, ASSISTANT PROFESSOR, INSTRUCTOR, prefer M.E. in C.E. Two or more years' college teaching experience, fair degree of specialization in hydraulics, familiar with highway engineering. Consideration given to professional experience. Salary, $3,200–$5,000 a year; 4-term basis. Location, Midwest. R-5905.

SALES ENGINEERS. (a) Sales Engineer, graduate C.E., 30–35; substantial experience with structural steel, which must include detailing on the board in connection with fabrication and erection. Will represent company to contractors, engineers, architects, and owners. Under supervision of a contract engineer. Salary, to $7,800 a year. Location, Chicago, Ill. (b) Sales Engineer, graduate engineer desired; 30–35; knowledge of handling engineering service to architects, engineers, owners (industrials such as breweries, food, and paint). Will represent company to clients on wooden tanks. Salary, $5,200 a year. Location, Chicago, Ill. R-5909.

STRUCTURAL ENGINEER, graduate, licensed, considerable experience carrying out complete design of railroad coal tipples and coal washing equipment. Must be able to do mechanical layout as well as structural calculations on buildings. Some estimating involved for engineering firm in Chicago. Salary, to $7,000 a year. Permanent. Location, Chicago, Ill. R-5914.

MUNICIPAL ENGINEER (supervising operating engineer), graduate or equivalent, 38–50, substantial experience with operations of a municipal filtration plant. Will supervise the over-all operations of a water works 20-million-gallon filtration plant for a municipality. Salary, $6,000–$6,500 a year. Location, Indiana. R-5921.

ARCHITECT; graduate, 30–40; experienced in all types of building construction, able to prepare construction details and perspective drawings for publication; should have experience in writing on architectural subjects or desire to do so for a national materials association. Salary open. Location, Chicago. R-5917 Rewr.

STRUCTURAL DESIGNER; grad. C.E.; 30–45; 10–15 years' experience with reinforced concrete on structures of all kinds; able to interpret specifications and plans and to describe and demonstrate appropriate methods and materials to satisfy requirements. Will contact architects, engineers, contractors, builders and principles individually and in groups to promote product use for a national materials association. Company car. Salary, $4,800–$5,400 a year. Travel 33%. Location, Chicago headquarters. R-5933.

UNESCO Book Program to Aid European Recovery

WITH AN APPROPRIATION OF $150,000, UNESCO recently launched a "Book Coupon Scheme" that will make it possible for educators, scientists, professional people, and others in war-devastated countries to obtain needed periodicals and text and reference books from other countries without currency exchange difficulties. Following a recommendation by the Commission's Panel on Books, the American Booksellers Association has been appointed to administer the program in this country.

Under UNESCO's coupon program, individuals in war-devastated countries may use their own currency to buy UNESCO book coupons which will be sent, together with the purchaser's order, to the publisher or his agent. In this country the ABA will transmit orders, pay publisher's bills in dollars, and forward the book coupons to UNESCO in Paris for redemption.

Fall Meeting of ASCE
Washington, D.C., Hotel Statler, Nov. 2–4

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Please reserve for my occupancy the following hotel accommodations:

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Dates of occupancy .....

Constructors Roll Million Yards a Week Into Garrison Dam

(Continued from page 32)

ite when concreting operations are egun there. It is expected that in he summer of 1950, peak traffic will xceed 150 loaded cars per day. Cars re delivered to the contractor's re-eiving tracks and empties returned o the marshaling yards at Riverdale unction by the Government, but uch spotting and moving as is re-uired in work areas is done by the ndividual contractors.

Permanent Town Built

The construction town of River-dale, a permanent feature, is located n the high terrace on the left bank bove the dam. To date 381 family ousing units, each with one to three edrooms, have been constructed ogether with a trailer court and ormitories. No family housing has een built for contractors' personnel. Operating and maintenance personnel f the completed project will be oused in 100 family-type units lassed as permanent.

Temporary units are both of the refabricated and site-built type. Permanent units are steam heated by a central heating unit but temporary nits have oil-fired hot-air furnaces. A church, theater, recreation build-ing, grade and high school, water treatment plant, dormitory hotel for unmarried employees, warehouses, garage and equipment repair facil-ities, hospital and concessionnaire store block have been built. Police and fire protection are furnished.

Progress to Date

Excavation and embankment oper-ations began in the powerhouse and outlet channel area on the right bank in October 1947. Similar work was started in the spillway cut in the east abutment in May 1949. As of September 15, 1949, 24,700,000 cu yd of material had been excavated and 18,000,000 cu yd placed in the em-bankment. The maximum yardage excavated to date to one day has been 175,000; in a six-day week, 1,021,524 cu yd, of which 90 percent was placed in embankment.

Garrison Dam is scheduled for completion in 1954. In that year also the first of the five 80,000-kw gen-erators is scheduled for installation. Two additional units completing the initial installation will be placed in 1955. Present studies indictae that installation of the remaining two units will be required by 1958. The Corps of Engineers, Garrison District, Riv-erdale, N.Dak., has charge of con-struction, headed by the writer as District Engineer.

CATALOG DIGESTS of ENGINEERING and INDUSTRIAL Interest

1 A-D MOTOR GRADER

Allis-Chalmers Mfg. Co.—A most attractive 32-page booklet is offered on the AD Motor Grader, which possesses increased clearances to handle more dirt, a new blade, more power, better traction, blade range, better operator performance and a rigid backbone. The booklet contains diagrams, descriptions, specifications, graphs, charts and features of the various attachments which you may need on your job.

2 AERIAL MAPPING

Aero Service Corporation—offers catalogs or literature covering its varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

3 AIR INLET VALVES

Simplex Valve & Meter Company—An essential booklet is Bulletin 125, for all engineers interested in pipe line construction and use. It describes fully and completely the theory and application of Air Inlet (vacuum breaking) valves and discusses why these should be installed on all thin-walled pipe lines where vacuum conditions might cause pipe collapse.

4 APPLIED SCIENCE BOOKS

John Wiley & Sons, Inc.—Catalog describing 1,400 titles in all fields of pure and applied science. Of particular interest to civil engineers are the recently published books: Creager and Justin's "Hydroelectric Handbook"; Wisler and Brater's "Hydrology"; Dietz' "Engineering Laminates"; Lewis' "Planning the Modern City," Volumes I and II.

5 ASPHALT CONSTRUCTION

The Texas Company—Step-by-step descriptions of the various types of asphalt construction and maintenance for streets, highways and airports are offered by two booklets. One of these publications is entitled "Road Building with Texaco Asphalt by the Pressure Distributor Method." The other is devoted to "Texaco Asphalt Paving—Plant-mixed Types." Useful tables for the road builder and instructions for unloading asphalt products from railroad tank cars are included in this literature, which is offered to interested persons without charge.

6 AUTOMATIC LINE OILER

Gardner-Denver Company—Information is available on a line oiler that protects against operating rock drills or other air-actuated equipment, without adequate lubrication. Known as the L012 automatic line oiler, this device shuts off the line air automatically when all the oil in the reservoir has been used.

7 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

8 CAST IRON PIPE

Cast Iron Pipe Research Assoc.—A 15-page brochure entitled "Advantages of Cement Linings for Cast Iron Pipe" has been released. This paper brings out the advantage of using cement linings to maintain a higher carrying capacity in pipes used for carrying water.

9 CAST IRON PIPE DATA

U.S. Pipe and Foundry Co.—Standardized Mechanical Joint Cast Iron Pipe & Fittings Catalog contains detailed data on U.S. standardized mechanical joint pipe and fittings, sizes 3 to 48 in., inclusive.

10 CENTRILINE PROCESS

Centriline Corp.—A 30-page folder entitled "The Centriline Process" sets forth the advantages and the effectiveness of cement-mortar linings for water mains. Pictures, with appropriate explanations, show the Centriline machine and water mains before and after reconditioning. Given also are specifications and methods applicable to typical pipe cleaning and cement-mortar lining contracts; a list of contracts already completed by the Centriline Process, and a section on physical tests of cement-mortar linings.

11 CHEM-O-FEEDERS

%Proportioneers, Inc.%—Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

12 CHLORINE GAS FEEDERS

Builders-Providence, Inc.—Bulletins 840 F1, F2 and F3T describe chlorinizers for metering chlorine gas and producing chlorine water solutions. Chlorinizers in both volumetric and gravimetric models are available, and may be adapted for semi-automatic, program or automatic proportional operation. Many unique features assure safe operation, accurate control and long life. Bulletins show flow diagrams and complete details of construction.

13 COLD WEATHER CONCRETING

Lone Star Cement Corp.—A 16-page illustrated booklet, giving detailed suggestions for minimizing winter concreting cost through the use of Incor 24-hr. cement. Contains actual job records where heat-protection costs were reduced by 50%, with similar savings in forms and overhead. Tables give mix proportions and approximate effect of temperature on compressive strength of concrete.

14 CONCRETE FORM-TIES

Richmond Screw Anchor Co., Inc.—Comprised of 8 sections devoted to the various styles, types and sizes of form-tying devices and other accessories for concrete construction, the new catalog is an extremely informative, fact-packed manual which shows by charts, pictures and word descriptions the proper selection and use of each of the items in the Richmond line. The catalog covers snap-tys, tyscrus, hanging systems, screw anchors and bolts, inserts and other devices.

15 CONCRETE GUN

The Prehy Company—A 4-page folder describes the construction, operation, and uses of the concrete gun. It is a portable machine entirely operated by compressed air. Because of the unique construction of the feed wheel and the air supply system which creates this even flow, the loss of material due to rebound will be reduced.

16 CONCRETE HAULER

Maxon Construction Co., Inc.—An 8-page, 3-color pamphlet "Dumpcrete Hauls and Places Quality Concrete at Lowest Cost," is full of on-the-job pictures showing non-agitating delivery and placement of concrete on jobs ranging from sidewalks to giant dam projects. Pamphlet L-106 describes how the Dumpcrete saves on original purchase price, and on daily maintenance, operation and upkeep—why superior centrally mixed concrete delivered in the Dumpcrete can be controlled more accurately for specification work.

There are 141 Digest items on pages numbered 86 to 100. Read all items for the literature of interest to you.

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Please have the literature indicated by the circled Catalog Digest numbers in the October 1949 issue sent to me without obligation.

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NOT GOOD AFTER November 15, 1949, for readers in the U.S., but requests will be accepted to December 30, 1949, from readers outside of this country.

Use This Free Service—Mail The Coupon To-day

CATALOG DIGESTS

17 CONCRETE PIPE

Lock Joint Pipe Company—Technical and descriptive data in illustrated pamphlet form describing the design, manufacture and installation of concrete cylinder pipe, prestressed concrete cylinder pipe and subaqueous pipe. Illustrated pamphlets and charts explaining flow and leakage tests, joint designs. Also a booklet tabulating the dimensions and weights of sewer and culvert pipe.

18 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N.B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

19 CONCRETE PIPE LINES

American Concrete Pipe Association—An official publication is now available to engineers. Contains information on flow of water in pipe lines, constructing pipe lines in open cut, constructing pipe lines in tunnels, jacking reinforced concrete pipe lines, subaqueous concrete pipe lines, concrete pipe sewers, drains, and airport drainage lines. This book is priced at $2.00.

N.B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

20 CONSTRUCTION DATA

A. C. Horn Co., Inc.—The 1949 edition of the Horn Construction Data and Handbook is free. It comprises 96 pages of charts, diagrams, tables, and construction details, as well as detailed descriptions and uses of Horn materials for building maintenance and construction. This is a standard reference book for maintenance men and engineers.

21 CONSTRUCTION SURVEYS

Portable Seismograph, Inc.—Complete information on Seismograph construction surveys and their use in securing subsurface data for construction and earth-moving projects is available. They will also supply descriptions of the seismic refraction method of making fast, accurate surveys to determine depth of bedrock; water table; width, depth and direction of old river beds; location and size of gravel deposits and other information essential to construction and excavation projects.

22 CONTROLLERS AND LAYOUTS

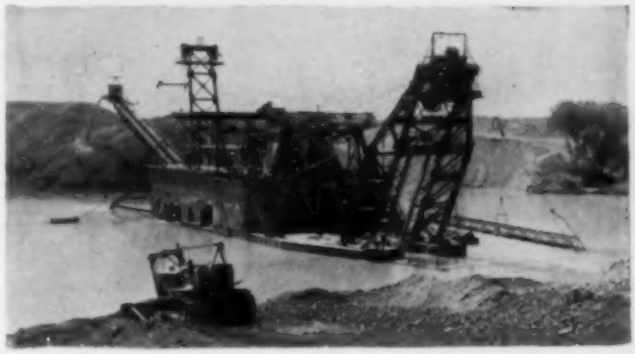
Simplex Valve & Meter Company—Bulletin 250 gives dimensional data on horizontal and vertical type controllers and clearance layouts for these units when using different type close-off arrangements. Type "S" rate controller for use in effluent lines from rapid sand type filters. This bulletin is of essential interest to the filter plant designing engineer.

23 CORE DRILLING EQUIPMENT

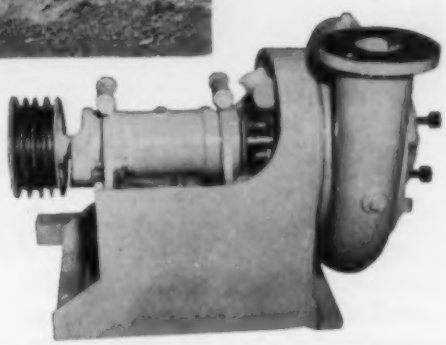
Joy Mfg. Co.—"Joy Core Drill Supplies and Equipment" is the title of a catalog on auxiliary core drilling equipment recently issued. For use by all owners or operators of core or diamond drills, this 36-page catalog, Bulletin D-18, contains illustrations and specifications for a complete line of core barrels, bits, drill rods and other equipment necessary for diamond core drilling operations.

Please remember industrial literature is costly. It is requested that you ask only for those booklets of particular interest to you.

3404 HOURS CONTINUOUS TROUBLE-FREE OPERATION



YUBA Dredge No. 20 working at Hammonton, Cal., is equipped with Model "S" Yuba pump



Model "S" 3" YUBA pump built for pumping sand in jig or sizing installations

Actual Performance Record of YUBA Model "S" 8" Pump

Here's what the superintendent of a YUBA 18 Cu. ft. bucket line dredge wrote us under date of Oct. 4, 1948.

> "For your information, the model "S" (8") mud pump #880 in operation at Dredge No. 4 on Sept. 30, 1948, had completed 3,404 hours of operation without trouble or repairs."

This same customer has since purchased another 8", Model "S" and he has in use several 3" and 6" pumps of the same type.

YUBA Model "S" pump is a centrifugal type, designed especially for dredging mud, sand, or muddy water encountered in sand and gravel operations. Special alloys are used in castings to ensure long life with minimum loss of time for repairs. Our aim in building pumps, as with all dredge parts, is to keep your plant running—you profit only when it is operating.

You, too, can get higher running time by equipping your dredge with YUBA pumps. For full details, write or wire us NOW.

SAND and GRAVEL OPERATORS AIM AT—

1. High running time
2. High yardage
3. Clean product
4. Low operating cost

They get all 4 with YUBA dredges and equipment

YUBA DREDGES — PROVED DEPENDABILITY

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Portable Dredge keeps two reservoirs free of silt!

The Corps of Engineers, U. S. Army, needed a portable dredge to remove accumulated silt from several reservoirs of the Washington Aqueduct water supply division which is an integral part of the Washington, D. C. water system. The operating machinery, consisting of the dredging ladder, dredging pump, hauling and hoisting machinery (designed and built by Ellicott for this 8-inch hydraulic dredge and placed on a hull of Navy wartime cubes) met the requirements of the U. S. Army Engineers to a "T".

Complete Line of from 6 to 30-inch dredges for all requirements.
64 Years of Experience with hydraulic dredges.
Undivided Responsibility—designed, built, delivered under one contract.
Proved Performance in the U. S. A. and abroad.

The dredge is *portable* . . . can be easily disassembled for shipment by truck from one land-locked reservoir to another. And, *operation is clean* . . . electric operation keeps deleterious substances out of the water.

If you have a dredging problem, see Ellicott first! Only Ellicott is equipped to design and build, *in its own plant*, any size, any type dredge for *any* kind of service. Write for free bulletin 780. ELLICOTT MACHINE CORP., 1607 Bush St., Baltimore 30, Maryland.

ELLICOTT *Hydraulic Dredges*

CATALOG DIGESTS

24 CORR-PLATE STEEL PILING

Caine Steel Co.—Complete description, specifications and photographs of typical installations are included in a new catalog. Corr-plate steel piling is the strongest piling per lb weight; cold rolled from open hearth steel; economical, light in weight; easy to handle, easy to drive and pull, and easy to transport (nestable). Can be used over and over again. Available in standard and interlocking sections. Used widely in excavation and construction of foundations, dams, retaining walls, docks, levees, bulkheads, sewers, disposal plants, etc.

25 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—An attractive 24-page catalog featuring the HD-5 crawler has been released. Photographs and cutaway views illustrate the "5's" track release mechanism, positive sealed truck wheels, and other features which simplify maintenance problems and assure longer life.

26 CRAWLER TRACTOR

The Oliver Corp.—has just published a 24-page catalog on their Model HG tractor, the smallest crawler tractor manufactured. The catalog has numerous application photos showing versatility, a story complete with photos of new engine features, steering principle and accessibility for maintenance and adjustment of all parts. Two pages are devoted to extra features, special attachments and allied equipment.

27 CRAWLER TRACTORS

International Harvester Co.—Three new, attractive, profusely illustrated, 24-page catalogs describe the new International diesel crawler tractors—A-153-MM, the TD-24 of 140 drawbar hp; A-179-MM, the TD-18A of 87 drawbar hp; A-178-MM, the TD-14A 60.5 drawbar hp. Mechanical features and complete specifications are presented.

28 CRUSHING AND SCREENING PLANTS

Austin-Western Company—Bulletin No. 1999 describes the latest Austin-Western two-unit and three-unit portable crushing and screening plants which have been developed for either pit or quarry use. How these plants are capable of delivering high tonnages of aggregate in accurately controlled sizes; and how the three units (primary breaker, primary and secondary) may be used separately or in combination, as desired, providing flexibility of operation, is contained in the bulletin.

29 DESIGN FOR ARC WELDED STEEL STRUCTURES

Air Reduction Sales Co.—A 300-page definitive work, the first of its kind to be published, was compiled by LaMotte Grover, M. ASCE, a recognized authority in the field of structural welding. The book covers: fundamentals of design materials, inspection, estimating, engineering control of welding and related operations, electrode requirements, specifications for welded connections for all sizes of rolled beams, and a series of diagrams for rapid design of welded connections. The price of this book is $3.00 postpaid.

N.B. There is a charge for this book. Make checks payable to the Air Reduction Sales Company.

30 DESIGN OF CONCRETE MIXES

Portland Cement Association—An attractive, 70-page booklet gives detailed information on the design and control of concrete mixes. A few of the well-covered topics are fundamental facts about concrete and other materials. It covers mixing, handling and transporting, curing and protection and special types of concrete. These subjects are illustrated with pictures, charts, and diagrams. The Appendix contains specifications and tests of interest to contractors. This booklet is free, but is distributed only in the United States and Canada.

31 DIATOMITE FILTER

Permutit Co.—Bulletin 3415 describes the operation and advantages of the diatomite filter which requires less space, saves cost of coagulants and saves in amount of backwash water. The improved type of filter element is completely rigid, resistant to corrosion and lacks wires or screens which may be easily damaged or clogged.

32 DOORS, STEEL ROLLING

Kinnear Manufacturing Company—The advantages, the economy, the construction features, and the general specifications of the various types of Kinnear wood and steel upward-acting type doors are fully discussed and illustrated in a new catalog and data book just published. Known as Bulletin 50, it gives information on insulation clearance requirements, methods of operations and controls, as well as the adaptability of the doors for many types of uses.

33 DRAFTING EQUIPMENT

The Frederick Post Co.—Of particular interest to drafting engineers, architects and field engineers is the new 19th edition Post general catalog. It deals with drafting materials, engineering supplies and equipment, all blue print, photographic and direct process paper, cloths and supplies. It was designed with one purpose in mind, to make it easy for the customer to find what he wants, find out all the essential information about products and, above all, make it easy for him to order what he wants quickly.

34 DRAFTING MACHINE

Keuffel & Esser Co.—A booklet explains and illustrates the construction and time-saving operation of the Paragon drafting machine, which combines the function of T-square or straightedge, triangles, protractor, and scales into one unit easily controlled by the left hand alone, leaving the right hand free for drawing.

35 DRY CHEMICAL FEEDER

Permutit Co.—Bulletin 3156 outlines the principles and design of the dry chemical feeder. The advantages of this type of feeder are: extreme accuracy, wide feeding range, stepless adjustment of dosage, reproducibility of feeding rate for any feeder setting, adaptability to either acid or alkaline chemicals.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

CATALOG DIGESTS

36 DUAL FUEL DIESEL

Worthington Pump & Machinery Corp.—Sixteen pages of detailed information on dual fuel engines make up Bulletin S-500-B45. The booklet has such outstanding features as the cross-section and external views of the dual plunger fuel pump and diagram of the automatic thermal air control. Many worth-while pictures, diagrams, specifications and charts are included.

37 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet, of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

38 ELECTRIC FISH SCREEN

Electric Fish Screen Company—An illustrated single sheet describes the **Burkey** method of positive fish control, employing specifically engineered electrode systems energized by electronic generators. Designed to prevent fish from entering hydro-electric plants, water systems, and pumping stations as well as to fence fish within lakes and private preserves. The control unit is harmless to marine life.

39 ELEVATED WATER STORAGE

Pittsburgh-Des Moines Steel Company—A new catalog, "Modern Water Storage in Elevated Steel Tanks," is now available. This 20-page bulletin includes tables, listing the capacity and the dimensions of various types of standard elevated steel tanks, a discussion of the economics of these various types, a discussion of the advantages derived from elevated water storage, 50 photographs of tank installations and a useful data section.

40 ELEVATED WATER TANK

The Chicago Bridge & Iron Co.—A 4-page leaflet describing the newly designed Watersphere has just been released. A modern elevated water tank of welded construction consists of a spherical tank supported on a single, cylindrical column. It is available in standard sizes from 25,000 to 100,000 gal capacity in heights of 50, 75, 100 and 125 ft to bottom. Special designs will be made up, however, for the above-mentioned standard capacities in special heights.

41 ERASER

Eberhard Faber Pencil Co.—The No. 51 Penta-Kleen eraser is made of a new compound that minimizes crumbling and eliminates smears. Unique in design, it has five flat sides which are excellent for cleaning broad surfaces. Then too, its 10 sharp corners and five knife-like edges are ideal for the most exacting erasures. Penta-Kleen won't slide, slip or roll on tilted drawing boards. Sample will be sent upon request.

42 EXCAVATOR

Harnischfeger Corp.—Bulletin X-122 covers a new 2½ to 3 cu yd excavator equipped with "Magnetorque" electric swing units in place of friction swingers. This feature alone eliminates all friction on swing and propel motions, enables more accurate starting and stopping, and greatly reduces both time and materials in maintenance.

43 FARM PONDS

Armco Drainage & Metal Products, Inc.—"Build a Farm Pond for Pleasure and Profit" is the title of a 20-page bulletin recently published to assist in water and soil conservation. How to design and build a farm pond is described in terms easily understood by the layman as well as by engineers and contractors. Information is included on the use of water control gates where the water level needs to be regulated or the pond drained for mosquito control or fish propagation. A section is also devoted to the repair of failed farm ponds.

44 FEEDER FOR DRY MATERIALS

Omega Machine Co.—Bulletin 20–23 describes a loss-in-weight type gravimetric feeder which handles almost any granular or powdered material, including lumps to 1¼ in. The feeder weighs, feeds, and records with an accuracy of 99% or better. Bulletin shows operating mechanism and auxiliary equipment, lists materials fed, and gives data for proportional control.

THE SUN NEVER SETS ON

% PROPORTIONEERS % Little Red Pump

%Proportioneers% Heavy Duty Midget Chem-O-Feeder — "The Little Red Pump" — is known and trusted in every corner of the world. To the Chinaman, African, and American alike it means safe, pure water. It handles the all-important jobs of water sterilization, taste and odor control, water softening, and dozens of other water treating applications. Because of its extremely simple, rugged construction, the Little Red Pump can be safely operated by almost anyone. It treats from a few gallons to a million gallons of water a day and feeds chemicals up to 7½ g.p.h. against pressures to 85 p.s.i. The chemical being fed shows plainly in the "See-Thru" plastic head and the action of the valves and diaphragm is clearly visible. Over 27,000 %Proportioneers% units right now are making this a healthier, better world to live in.

Write for Bulletin HDM-2

FEEDS . . .
Hypochlorite Solution
Hexametaphosphate
Alum Solution
Ferric Chloride
Soda Ash
Sodium Fluoride
and other water treating chemicals

% PROPORTIONEERS, INC. %
PROVIDENCE 1, R. I.

45 FIRE PREVENTATIVES

M & H Valve & Fittings Company—Catalog No. 40 describes and illustrates underwriters' and factory mutual approved fire hydrants, gate valves, indicator posts, swing check valves and underground fittings for automatic sprinkler and private fire protection systems.

Please do not waste material. Ask only for what you can use.

46 FOOTWALKS

Wm. F. Klemp Co.—offers its 1949 edition of their catalog entitled "Klemp Open Steel Grating and Stair Treads, the Perfect Structural Steel Flooring," containing information on riveted and welded grating, structural steel footwalks, bridge decking and drain grating, for use in refineries, power houses, sewerage units, mezzanine storage rooms, catwalks, heavy industries, bridges, etc. Fully illustrated, the book includes a safe-load table, and complete engineering data.

47 FORM LINING

United States Rubber Co.—An attractive 12-page booklet gives detailed information on Hydron, a new absorptive form lining. The booklet covers the various tests made, specifications and installations through diagrams, charts and on-the-job pictures.

48 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

Prompt return of your coupon will bring your literature to you sooner.

Question What would happen — to your plant floors if they were pounded by tractors like that below?

PHOTO BY COURTESY OF CATERPILLAR TRACTOR CO. PEORIA, ILLINOIS

Answer NOTHING — nothing at all — they'd "take it" and remain solid, level, unbroken *if* protected by

KLEMP SURE FOOTED AS A CAT HEXTEEL Heavy Duty Surface Armor

Klemp HEXTEEL
HEAVY DUTY SURFACE ARMOR

Lay HEXTEEL over floor—lock—fill with concrete or mastic—trowel flush with grid top. That's all!

For more than 10 years Klemp HEXTEEL has armored floors of the big Caterpillar plant. Over these floors vast tonnages of materials and products have rolled every working day. Yet the floors today are as solid, level, and free from faults as at the beginning. Neither pounding tractor lugs, nor 30-ton Sherman tanks could damage the invincible HEXTEEL protection. At surprisingly low cost your floors can be similarly protected—*maintenance eliminated!*

Check these HEXTEEL advantages

1. HEXTEEL'S heavy steel mesh holds concrete, asphalt or any filler in tight 1¾" hexagons. *Banishes cracking, buckling, pot-holes, ruts and breaks forever!*
2. Traffic travels smoothly on seamless flush top of mesh—in all directions.
3. HEXTEEL—armored floor outlasts the buildings. Free from maintenance.
4. Rapidly installed by unskilled labor. Tools are lent to customers by Klemp Company.
5. Can be applied over old or new floors, wood, cement, terazzo, asphalt or mastic. Self-anchoring construction patented.
6. No welding nor riveting. Fireproof. Non-skid. Most economical steel armor made!

SEND FOR COMPLETE KLEMP CATALOG. Also shows Klemp Floorsteel, flexible floor armor that rolls out like a rug—Klemp Open Steel Gratings—Klemp Steel Safety Mats. Write

WM. F. KLEMP CO.
"Steel Flooring Specialists"
6610 S. Melvina Ave. Chicago 38, Ill.

49 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Literature on the construction of difficult and unusual foundations; description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

50 FOUNDATIONS AND SOIL BORINGS

MacArthur Concrete Pile Corp.—A booklet giving concise data on pile foundations describes cast-in-place, composite, steel, sectional pipe, timber and H piles. Also given are notes on soil and rock exploration, and pile, driving problems with special notes and engineering information covering 38 years' experience installing cast-in-place concrete piles.

51 FOUNDATIONS AND UNDERPINNING

Underpinning & Foundation Co., Inc.—Of special interest to engineers is literature describing steel pipe pile foundations and underpinning by pioneers who have specialized in this field; application, design and methods are included. The scope of this Company's work also includes open and pneumatic caissons, subway and tunnel construction, sinking of mine shafts, cofferdams, and all other types of substructures and heavy construction.

52 FRAME CONSTANTS

Portland Cement Association—A handbook of frame constants—especially useful in frame analysis—offers tabulations of fixed end moments, and stiffness and carry-over factors for members with parabolic and straight haunches. This offer is free, but is distributed only in the United States and Canada.

CATALOG DIGESTS

53 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial, power and refinery walkways, stairways, driveways, trucking aisles, ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

54 GRID ROLLER

Hyster Co.—A grid roller consisting of two 5-ft diam wheels or rollers attached to a frame for towing behind a motor grader or tractor is fully covered in an 8-page booklet. The open mesh design of the grid surface results in a high degree of compaction in a minimum number of passes. The roller may also be used for salvaging and maintaining black-top pavement.

55 GROUTING METHODS

The Prehy Company—A 16-page illustrated booklet, describes various grouting methods. It contains recommended mixes for each type of job and describes uses of grouting for soil stabilization, solidification of fractured rock, water sealing, drypack concrete, and cast-in-place piles.

56 HAND LEVEL

Keuffel & Esser Co.—A booklet describes the precision-made hand level for speedy and convenient surveying. It also explains and illustrates how one man can use it for rough grading, locating contour lines, etc., and how he, with an assistant and a rod, can take cross section, set slope stakes, etc.

57 HARDSURFACING GUIDE

The Lincoln Electric Co.—A reference guide in convenient filing form for selecting the correct type of hardsurfacing electrode for all types of hardsurfacing applications is offered. Contains chart classifying types of electrodes according to relative resistance to abrasion and impact. Lists types of electrodes according to type of weld deposit and their typical applications. Complete procedures for using the different types of electrodes are also given.

58 HARDFACING LINE

Air Reduction Sales Company—A 16-page, 2-color, profusely illustrated booklet, which also serves as a hardfacing catalog, describes each of Airco's new alloys in complete detail. Included are data on typical uses, specifications, application technique, deposit hardness, color markings and deposit analysis. Every page is full of helpful, authentic information on how to combat wear and increase equipment work-life.

59 HEAVY DUTY EQUIPMENT

Caterpillar Tractor Co.—A complete package of heavy duty equipment that is "Caterpillar" powered, features the illustrated contents of a 16-page booklet, Form 12311, "Slope State to Final Grade with 'Caterpillar' Equipment." Presenting the reader with a detailed method of pioneering the land through the application of machines engineered and designed for low cost clearing, short haul work and initial cut performance, this booklet emphasizes its informative material with pictorially displayed projects.

60 HIGHWAY BRIDGE SPECIFICATIONS

American Association of State Highway Officials—Recently published is a 284-page clothbound book entitled "Standard Specifications for Highway Bridges." Made up in four main divisions with 72 subordinate sections, all details of general provisions, construction, design, and materials are covered. Four Appendices carry tables of moments and shears, steel column formulas and graphs, a chart of truck, train, and equivalent loadings and a diagram of permissible unit stresses for rectangular concrete columns. This book is priced at $3.00.

N.B. There is a charge for this book. Make checks payable to the American Association of State Highway Officials.

Order Your Literature Now by mailing the coupon on page 86 to CIVIL ENGINEERING.

CATALOG DIGESTS

61 HOE FRONT

Hyster Co.—A 12-page booklet describes the 1/3 cu yd capacity hoe front which has been added to the dragline, clamshell and crane features of the tractor-mounted hystaway. Installation of the hoe front on a "Caterpillar" D7 or D8 tractor can be accomplished without major alteration to existing machines. Full tractor mobility and maneuverability are retained with the hoe in place and utility use of a bulldozer mounted on the back of the tractor is possible.

62 HOIST DRIVE

General Electric Company—This drive is recommended for hoists which handle a wide range of loads, and where accuracy, speed, refined performance, and safety are important. It provides maximum speeds in the raising and lowering of the empty hook, automatically controlled speeds in hoisting or lowering safe overloads, and an inherent stall characteristic which prevents the lifting of excessive overloads. Its advantages on overhead traveling cranes, hammerhead cranes, cargo winches, revolving derricks and other hoists are described in the booklet "Maxspeed Hoist Drive," which also reports on the performance of this drive in speeding concrete placement.

63 HOUSE CONNECTION PIPE

Johns-Manville Corp.—Form TR-67A is an 8-page folder describing the advantages of Transite house connection pipe for house sewer lines. It tells how this asbestos-cement pipe is engineered to prevent root clogging, a major source of trouble and expense to the home owner. The folder also shows typical house connection layouts, lists weights and dimensions of pipe and fittings and contains a brief description of installation methods.

64 H-PILES

Bethlehem Steel Co.—A valuable and worthwhile booklet to the construction engineer is Catalog 223. The book thoroughly covers the history, characteristics, test pile data, life of steel, designs of installations and general specifications of H-piles. Dimensions, diagrams, tables formulas and pictures are included.

65 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel, containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

66 INFILTRATION COLLECTORS

Ranney Method Water Supplies, Inc.—A seventeen page booklet, entitled "Industrial and Municipal Water," describes the basic principles involved in the design and construction of horizontal infiltration collectors. Included are a list of completed installations and reprints of several technical articles which summarize actual operating experience. Four diagrams and eight construction photographs illustrate the text of the booklet.

67 IRON-CLAD CONCRETE FLOOR

The Master Builders Co.—A 36-page illustrated booklet showing that the Masterplate floor, having an iron-armored surface about 1/8 in. thick, wears at least 5–6 times longer than a plain concrete floor. Discusses the additional features of spark resistance, easy-to-clean, color, static dissemination, non-dusting, corrosion resistance, non-slip and economy. Job pictures show typical installations. Booklet gives detailed directions for laying a Masterplate floor—for both new construction and resurfacing old floors.

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CATALOG DIGESTS

68 LAYKOLD FIBRECOAT

Stancal Asphalt & Bitumuls Co.—An illustrated folder describes Laykold fibrecoat, a mineral-armored asphalt for cold application protection of metal, masonry and asphalt surfaces. This product has passed the most rigid weathering tests known. It sells for less than $1.00 per gal.

69 LEROY LETTERING BOOKLET

Keuffel & Esser Co.—A Leroy lettering set enables any draftsman to do perfect lettering with speed and ease. Fully illustrated, this booklet (A13) gives complete information on Leroy lettering sets, templates, scribers, pens and accessories. Several new templates as map welding; electrical symbol; isometric drawing templates; reversed, condensed, and outline Gothic, Cheltenham, and Greek alphabet templates are included.

70 LONG LINE RULING PENS

Keuffel & Esser Co.—offers a booklet which describes and illustrates the new time-saving Marathon long-line ruling pens. These pens have an extra-large ink capacity so they can draw five to eight times more lines between fillings. They are also nonblotting and easily cleaned.

71 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describing mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

72 METERING FLUID FLOWS

R. W. Sparling—Practical suggestions for the metering of fluid flows are contained in Sparling Bulletin 310. The adaptability of the propeller-type meter to different problems is illustrated; graphs show accuracy and head loss curves over wide range of flows in different size lines. Details of instrumentation, prices, etc., are given.

73 METRIC WALL CHART

Robert S. Mayo—A wall chart has been designed for the rapid conversion of meters to feet and inches. It is stated to be very valuable to engineers who must frequently convert meters to feet, or vice versa.

74 MIGHTY MIDGET

R.P.B. Corp.—A 4-page booklet gives detailed information on the mighty midget. New features now incorporated in this machine are said to make it easier to handle, and gains in yardage of concrete broken per day are claimed. Specifications, standard tools with which the midget is now equipped and pictures are included in this attractive offer.

75 MODERN WATER PRE-TREATMENT

The Dorr Co.—A new 8-page, 2-color leaflet contains brief descriptions and photographs of all Dorr equipment available for water pre-treatment in the municipal and industrial fields. Also included in Bulletin 9141 are flow diagrams and a convenient table of basic design data for plant units treating various types of water.

76 MOTOR GRADERS

Caterpillar Tractor Co.—A 16-page booklet entitled " 'Cat' Motor graders Do the Job," designated as Form 12258, has been released. Illustrated with applications of precision ditching, bank shaping, general road maintenance, mixing road surfaces, terracing and snow removal, this publication offers performance records on coast-to-coast projects by these units.

77 OPEN STEEL FLOORING

Kerlow Steel Flooring Co.—A 40-page catalog on open steel flooring for bridges contains latest engineering information on design and selection of grating and stringers. Catalog describes various designs and their applications for open flooring and filled slabs, with dimension charts, complete specifications, selection and installation data for each design.

CATALOG DIGESTS

78 PILES

Raymond Concrete Pile Company—Raymond Standard and Step Tapered Piles are described in literature which also includes information on the scope of Raymond's activities which cover every recognized type of pile foundation including poured concrete, precast concrete, composite wood and concrete, steel, pipe, and wood. Raymond's activities and experience also include the construction of caissons and construction involving shore protection, shipbuilding facilities, and harbor and river developments.

79 PILES AND CAISSONS

Western Foundation Corporation—A new 12-page catalog describes constant diameter piles and caissons which carry the full foundation load to underlying bearing strata. Sketches in 4 colors show how Button Bottom, Pedestal and Caisson Piles are formed and cast in place. Composite piles composed of sections of pipe and thin shell are illustrated as well as the more common wood and concrete composite pile. A tested driven H-core composite is shown for the first time; an H-section is driven through an already driven casing to avoid friction of upper strata and secure high capacity on the core itself which is encased in load-bearing concrete. Special attention is given large-capacity uncased piles to overcome the ever-increasing unit cost and the imminent shortage of steel.

80 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—Descriptive information and engineering data on Monotube steel piles. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: easy handling, speedy driving, economical field extendability, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

81 PNEUMATIC GROUTER

Robert S. Mayo—Bulletin No. 13 illustrates the Mayo pneumatic grouter. This is a very simple machine and since there are no moving parts within the grout, will last for years. While this machine has only a 3½ cu ft capacity, it will place as much grout as the 10 cu ft "Mixer-Grouter."

82 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc.—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by using an instrument weighing only 8½ ozs. This will be of interest to engineers who have occasion to make rough surveys, check grades and levels, or lay out roads or lines.

83 POWER GRADERS

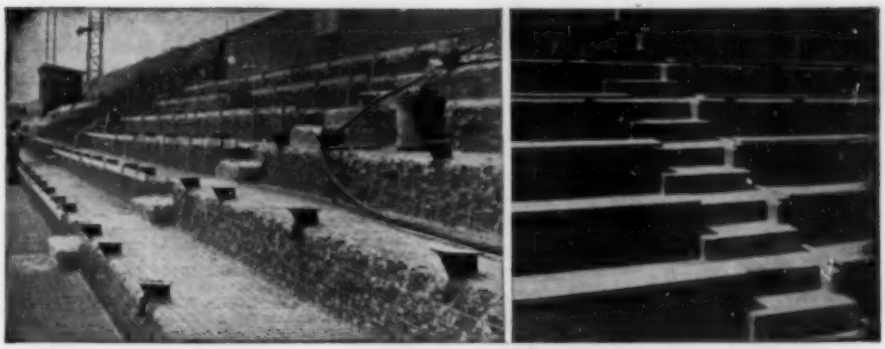
Austin-Western Company—A 28-page Catalog AA-2019 pictures and describes the "99-H" and Master 99 Power Grader with exclusive All-Wheel Drive and All-Wheel Steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are complete specifications, a description of exclusive design features and detailed illustrations of the attachments.

84 POWER UNITS

Allis-Chalmers Mfg. Co.—A series of booklets in reference to L844, B125, W201, E563 and U318 is offered to the engineer. All booklets are composed of diagrams, specifications, installation dimensions and brief descriptions—all contributing to low operating and maintenance costs.

85 PRECISION SURVEYING INSTRUMENTS

Brunson Instrument Company—Completely illustrated 2-color folders describing the operation and detail of Brunson ball-bearing engineers' transits, light mountain transit, engineers' dumpy level, engineers' wye level, builders' level, engraved permanent face level rods, and the new hand level are now available with pocket-size handbooks of operation, maintenance, and adjustment of Brunson ball-bearing transits and levels.



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CATALOG DIGESTS

86 PRELIMINARY SURVEY PROCEDURE

American Paulin System—This booklet, available without charge to all civil engineers, is published in the interests of greater efficiency and economy of time and labor in the making of preliminary surveys under all conditions. The observer and author of this work, Raymond A. Hill, M. ASCE, explains in detail the practical use of the Paulin System Altimeter in connection with all branches of preliminary field surveying. Geologists, scientists, topographers, surveyors and educators will find this book of interest and technical value.

87 PUMPS

Fairbanks, Morse & Co.—A 16-page bulletin entitled "Non-Clog Sewage and Trash Pumps" is offered. These pumps are designed to bring efficiency up and operating costs down. They are widely used in pumping unscreened sewage, storm water, industrial waste, sardines, beet pulp, food solids, paper pulp and numerous other materials. Trained field engineers are ready to assist the purchaser on deciding upon the equipment best suited for the work to be done.

88 REFUSE INCINERATION

Pittsburgh-Des Moines Steel Company presents a 24-page bulletin on municipal refuse incineration which discusses the problem of disposal of garbage and rubbish, gives data on per capita production of garbage and rubbish, describes incineration as a means of refuse disposal and sets forth the requirements for satisfactory incineration. It goes on to describe the Pittsburgh-Des Moines incinerator and includes typical plant layout, detail views which illustrate the operation and construction of the incinerator furnace, and photographs of 22 of their incinerators which are in successful operation.

89 SEISMOGRAPHS

Century Geophysical Corp.—The construction seismograph is being used by civil engineers for the determination of bed rock and/or depth of overburden. Refraction seismology has been used for many years in the exploration for petroleum reserves and has now been simplified for use in the engineering field. Catalog 103 is a brochure explaining the theory and application of the equipment, including photos and simplified interpretation procedure.

90 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

91 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 001. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment, air inlet and air release valves.

92 SIMPLEX SOLAR SHIELD

Claude H. Wall—Engineers, surveyors and instructors will be interested in securing this booklet on a new device for Solar observations. The Simplex Solar Shield has been designed to give accurate results with the ordinary minute-reading transit and relatively greater accuracy with instruments of higher precision.

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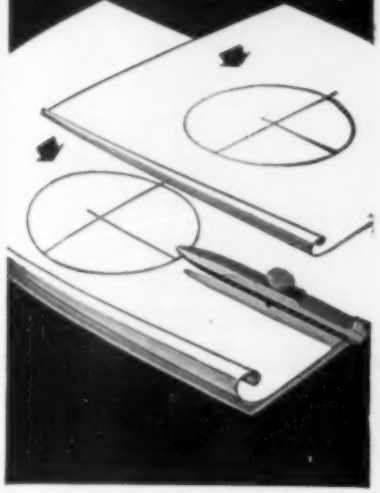

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CATALOG DIGESTS

93 SNOW PLOW-POWER GRADER

Austin-Western Co.—Bulletin AD-2092 describes the Sicard rotary snow master, used as an attachment with power graders. The advantages of 4-wheel drive and steer in connection with rotary snow plow operation are fully discussed and illustrated. The controllable wrist-action telescopic casting chute of the snow master is shown handling all types of snow removal including loading trucks from either side. This catalog describes and pictures snow removal under almost every condition both in opening and widening streets and highways. Brief specifications are also included.

94 SOIL STABILIZATION

Harnischfeger Corp.—Bulletin S-7 tells how modern stabilization methods stepped up soil-cement placement on the new Texas CAA airfield. It's an 8-page bulletin filled with factual information and on-the-job photographs.

95 SPEED-LAY PIPE SYSTEMS

Albert Pipe Supply Co., Inc.—A 5-page brochure describing "packaged" pipe line for temporary and semi-permanent air, gas and water lines is offered. This line is available in sizes 2 to 12 in., or larger if desired. It is lightweight, portable, easily assembled and available for prompt shipment. Includes pipe, couplings, fittings, adapters and valves where necessary.

96 SPEED PATROL

Allis-Chalmers Mfg. Co.—An 8-page 2-color pamphlet is offered on the W Speed Patrol. Ditching, grading, maintenance and construction—all these jobs and many more make the new W Speed Patrol the most versatile light grading tool ever offered. Not only is it master of every maintenance and light grading job, but it is also a real money saver.

97 SPIRAL HEAT EXCHANGER

The Dorr Co.—A 4-page, 2-color leaflet covering a method of heating sewage sludge digesters by external means is offered in Bulletin 6281. It contains photographs and a description of the equipment as well as operating results, design data, advantages and specifications.

98 STEEL BEARING PILES

Carnegie-Illinois Steel Corp.—A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past uses and applications.

99 STEEL FLOORING INSTRUCTIONS

William F. Klemp Co.—offers its 1949 edition of a new technical manual entitled, "Instructions for Laying Klemp Hexteel and Floorsteel." Hexteel heavy-duty surface armor is an open-steel grid, solid, enduring and self-anchoring. Floorsteel, flexible floor armor is an open steel mat. Both are used to armor and reinforce bridges, docks, air landing strips, loading platforms, industrial floors, heavily traveled highways and catalytic cracking units. The book contains complete engineering data.

100 STEEL FORMS

Robert S. Mayo—Bulletin No. 12 illustrates steel forms which have been built for various tunnels and sewers in the United States and South America. Each of these jobs was specially designed and every proposal required its own design and quotation. Also included is a description of tunnel shields for subaqueous construction. Air lock illustration will be found on the last page.

101 STEEL JOISTS

Laclede Steel Company—A 4-page booklet entitled "Laclede Steel for Building Construction contains detailed data on steel joists." The booklet explains three types of bearing ends for joists, purlins, and struts. A page is dedicated to various products manufactured by the company for building construction.

102 STEEL JOISTS AND ROOF TRUSSES

Laclede Steel Company—A 4-page booklet titled "Laclede Steel Joists and Roof Trusses" is now being offered. Information on steel joist sections used as truss members in prefabricated roof construction is fully explained. Both products are being used for industrial plants, warehouses, stores, office buildings, and docks.

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CATALOG DIGESTS

103 STEEL SHEET PILING

Carnegie-Illinois Steel Corp.—A 56-page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections; the straight web, the arch web, and Z-piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

104 STEEL TUNNEL SUPPORTS

Commercial Shearing & Stamping Co.—A 38-page booklet describing steel tunnel supports, with various methods of use, and installation for water, sewers, railroad and highway tunnels, also their use for caissons, coal mine entries, overcasts or room roofs. This booklet shows actual applications of the various types of supports in different methods of tunnel driving. Also offered is a 272-page book, entitled "Rock Tunneling with Steel Supports," for which a charge of $2.50 is made.

N.B. There is a charge for the latter book. If it is desired, make checks payable to the Commercial Shearing & Stamping Company.

105 STRUCTURAL SHAPES

Carnegie-Illinois Steel Corp.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails, and corrugated sheets.

106 SUBSURFACE EXPLORATION

The Giles Drilling Corp.—An 8-page pamphlet describes advanced subsurface exploration techniques in test borings for engineering. Emphasis is laid upon the fact that every engineering exploration presents its own individual subsurface conditions and problems. This places a premium upon correct field technique and interpretation.

107 SUMP PUMP

Gardner-Denver Co.—How the Sump Pump, operated by a vane type air motor, utilizes top suction to eliminate breaking the pump shaft seal by water pressure is told in a recent bulletin.

108 SURVEYING ALTIMETER DEVELOPMENT

American Paulin System—offers their interesting and instructive publication entitled "Origin and Development of the Barometer and Altimeter." This booklet will acquaint civil and field engineers with the basic differences between their system of instrumentation and all other types in the field of surveying altimeters.

109 SURVEYING ALTIMETERS

Wallace & Tiernan Products, Inc.—Test results of W&T altimeters using various methods of altimetry and a means of producing contour maps from aerial photographs and altimeter surveying are given in technical reprint RA-2003A.

110 SURVEYING—COATED OPTICS SYSTEM

The David White Co.—A 40-page bulletin, known as Bulletin 1049, completely describes the coated optics system used in their surveying instruments and also shows two or three new models on which they are in production.

111 SURVEYING INSTRUMENTS

W. & L. E. Gurley—Bulletin No. 50, an illustrated 50-page catalog describing the complete line of Gurley engineering instruments is offered. Detailed analyses are included of transits, engineers' levels, alidades and topographic instruments and equipment. Hydraulic measuring instruments, water level indicators and recorders, field supplies and wind instruments are also included.

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